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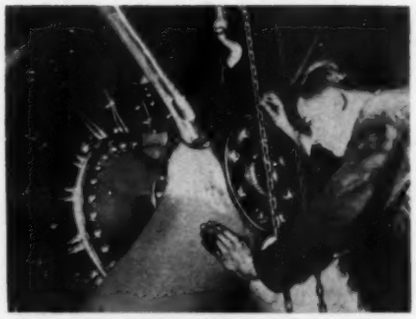

Power in the Air—*Defense needs have pushed small-lot methods of aircraft engine manufacture out of the picture in favor of modern straight-line technique*

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VOLUME 85 NUMBER 13

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MAJOR ARTICLES

Oxyacetylene Flame Hardening.....*J. G. Magrath* 581
Proper Molds for Plastics.....*George P. Lehmann* 584
Small Shop Stock Control..... 588
Spun Heads Save Time.....*J. J. Molette and J. C. Bohan* 591

ARMAMENT SECTION

Wright Turns to Line Production.....*P. W. Brown* 595

IDEAS FROM PRACTICAL MEN

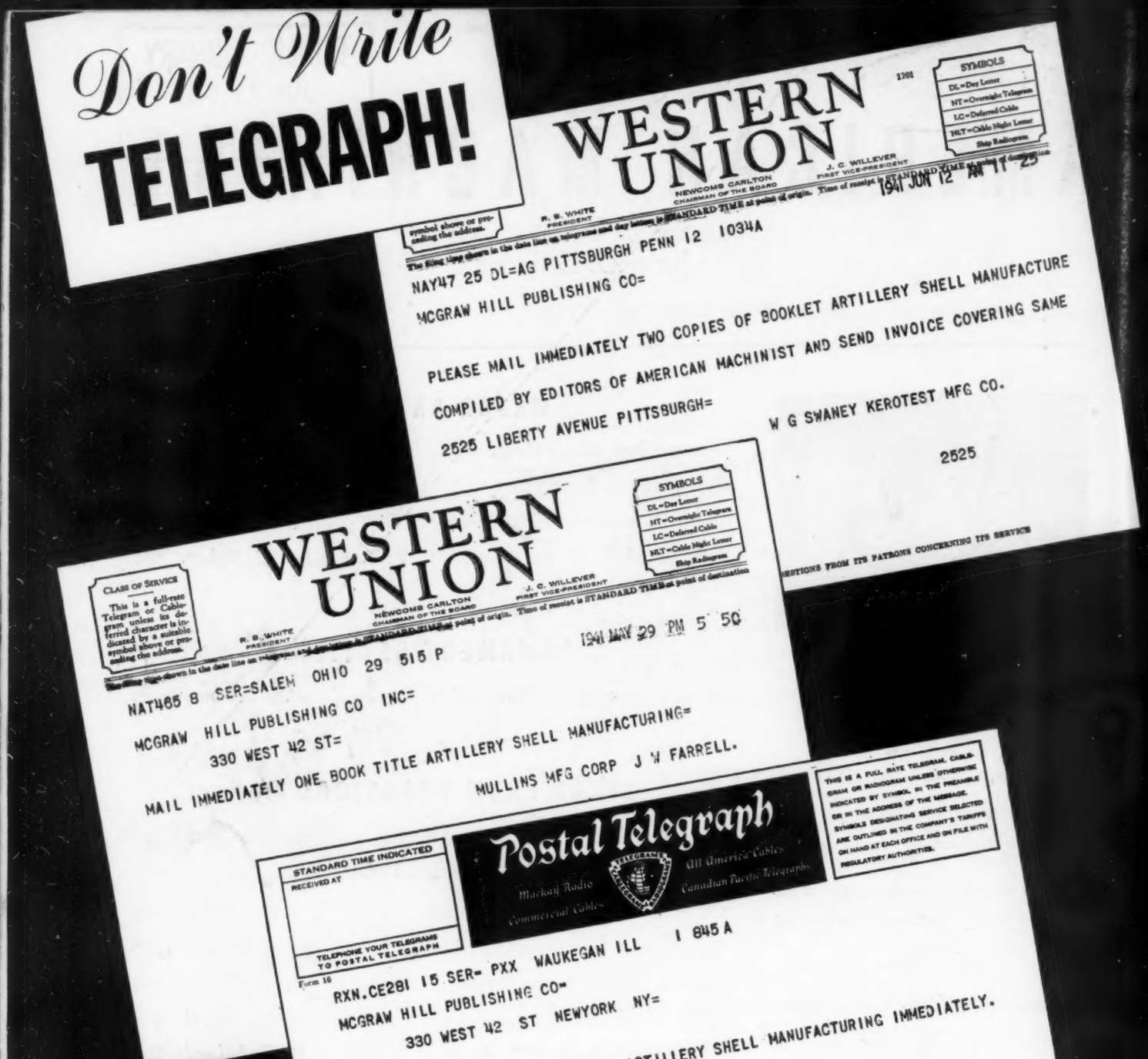
Long Roll Stiffened With Truss Rods.....*Martin H. Ball* 592
Forming Dies Built up from Welded Plates..... 592
Offset Studs Turned in the Lathe.....*J. W. Gerdel* 593
Tool Holder for Heavy-Duty Boring.....*Arthur Havens* 593
Threads With a Spring Caliper.....*H. B. Martin* 593
Motion Study Reduces Labor Costs.....*O. W. Habel* 594
Setting Walschaert Valve Gear.....*E. G. Eklund* 594

NEWS OF THE INDUSTRY

Gaging Business..... 622b
Inside Detroit..... 622g
Watching Washington. 622i
Names in the News... 622k
Plant Expansion..... 622k
Obituaries..... 622l

DEPARTMENTS

Reference Book Sheet.. 619
Editorial..... 622a
Shop Equipment News. 623
New Materials..... 632
Trade Publications..... 636
New Books.....adv. 51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This is another piece of striking evidence that if it's new and necessary in Metal-Working, you'll find it first in American Machinist. Read every copy from cover to cover—keep yourself informed about your industry and your job—on peacetime products and on defense items.

And if you are making—or planning to make—shells, and haven't our data on "Artillery Shell Manufacture", better send in your dollar today for the complete 128-page, 8¾ x 11⅝ in., two-color data book. Our supply is going fast.

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THE NEW GLEASON AUTOMATIC SURFACE HARDENING MACHINE

FOR HARDENING GEAR TEETH WITH OXY-ACETYLENE FLAME

With this new machine all the advantages of flame hardening are profitably extended to medium and small-size bevel, spur and internal gears, sprockets and the like.

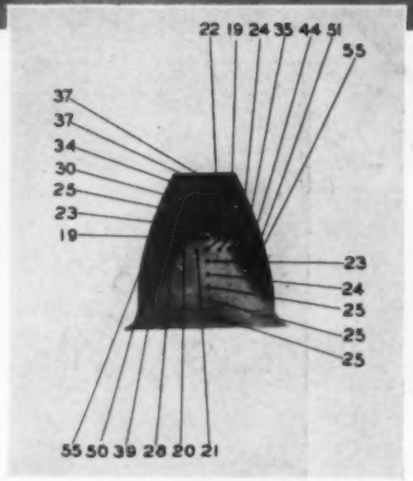
Both sides of a tooth are hardened simultaneously without distortion. Each tooth is hardened in exactly the same length of time and to the same depth as every other tooth. The machine is fully automatic in operation including indexing from tooth to tooth.

Straight-line cams guide the burners along the tooth, and on spiral bevel and helical gears the work rolls in timed relation to the torch advance so that the burners accurately follow the lengthwise tooth curve. Hydraulic control varies the burner speed to allow for heat accumulation ahead of the burners and on bevel gears to compensate for the taper of the teeth; the control also increases the burner speed at the ends of the teeth to prevent overheating.

Write for complete information.

CAPACITY

Pitch Dia., maximum	
Bevel Gears	33"
Spur and Helical Gears	26"
Internal Gears	21½"
Pitch, maximum	1½ DP
Face Width, maximum	4"
Floor Space	36" x 58"



Etched cross-section of hardened gear tooth. Rockwell "C" readings show gradual change from hard, durable tooth surface to tough, shock-resistant core.

GLEASON WORKS

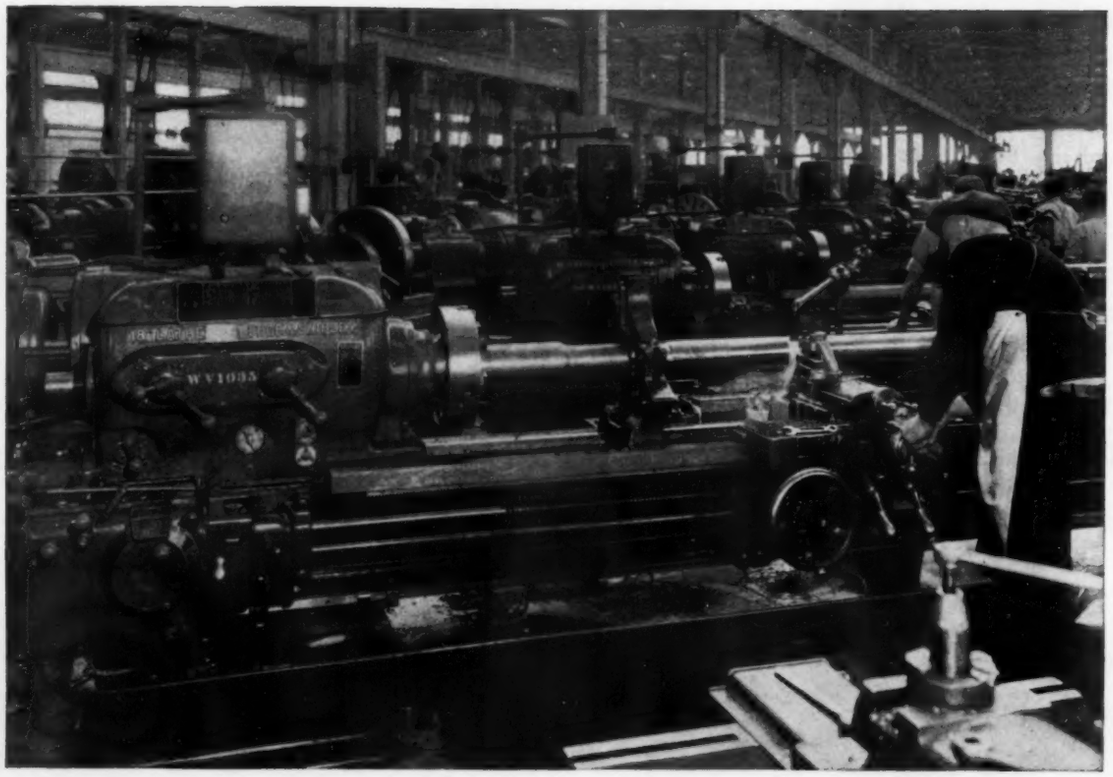
Builders of Bevel Gear Machinery for Over Seventy-five Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.

MORE GUNS *for National Defense*

KNOWN THE WORLD OVER
L & S LATHES

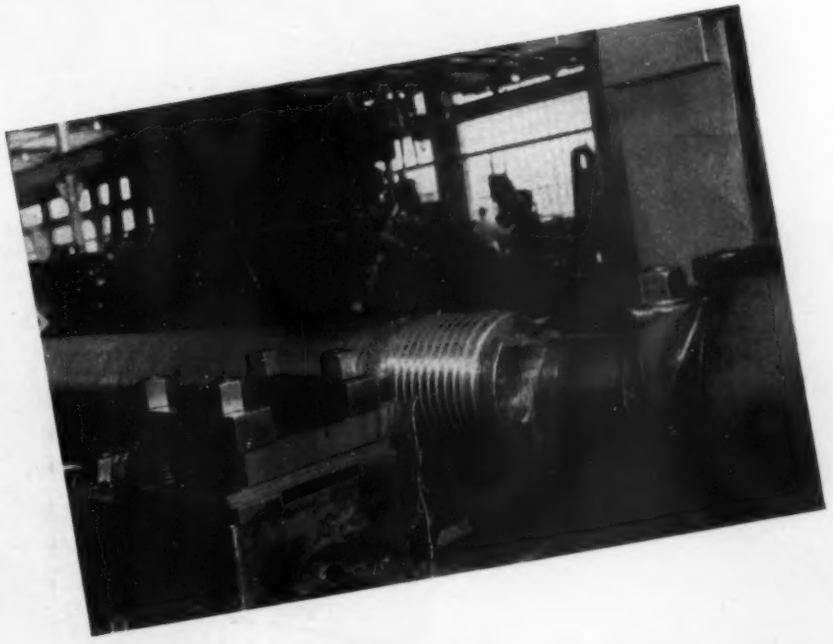
Bottom: Battery of five Lodge & Shipley 18" Selective Head Lathes installed in a U. S. Arsenal for rough and finish turning of 37 Millimeter gun tubes. Above is a close up view of one of these lathes in operation. Sturdy construction enables Tungsten Carbide Tools to be used on this important work.



Right: Rough turning a 150 inch long gun tube on a Lodge & Shipley 20" lathe. The Carboloy Tool takes a ⅜" deep cut in this tough material at a speed of 258 s.f.m.

Below: Another operation on a Lodge & Shipley 36" Lathe. A thread of modified Acme form 0.20" deep, 0.750" pitch being cut in the end of a gun tube. Roughing and finishing cuts are performed, the latter utilizing three separate tools for bottom, pressure side and clearance side of the thread.

Turning the tough material from which gun tubes are made is a good test of a lathe's ruggedness and accuracy. At the Arsenal pictured above more than a dozen Lodge & Shipley lathes are used for straight, rough, finishing turning and thread cutting on 37 millimeter and 3 inch anti-aircraft gun tubes. Many of these lathes are equipped with special differential taper attachments for machining long tapers on guns at one setting.



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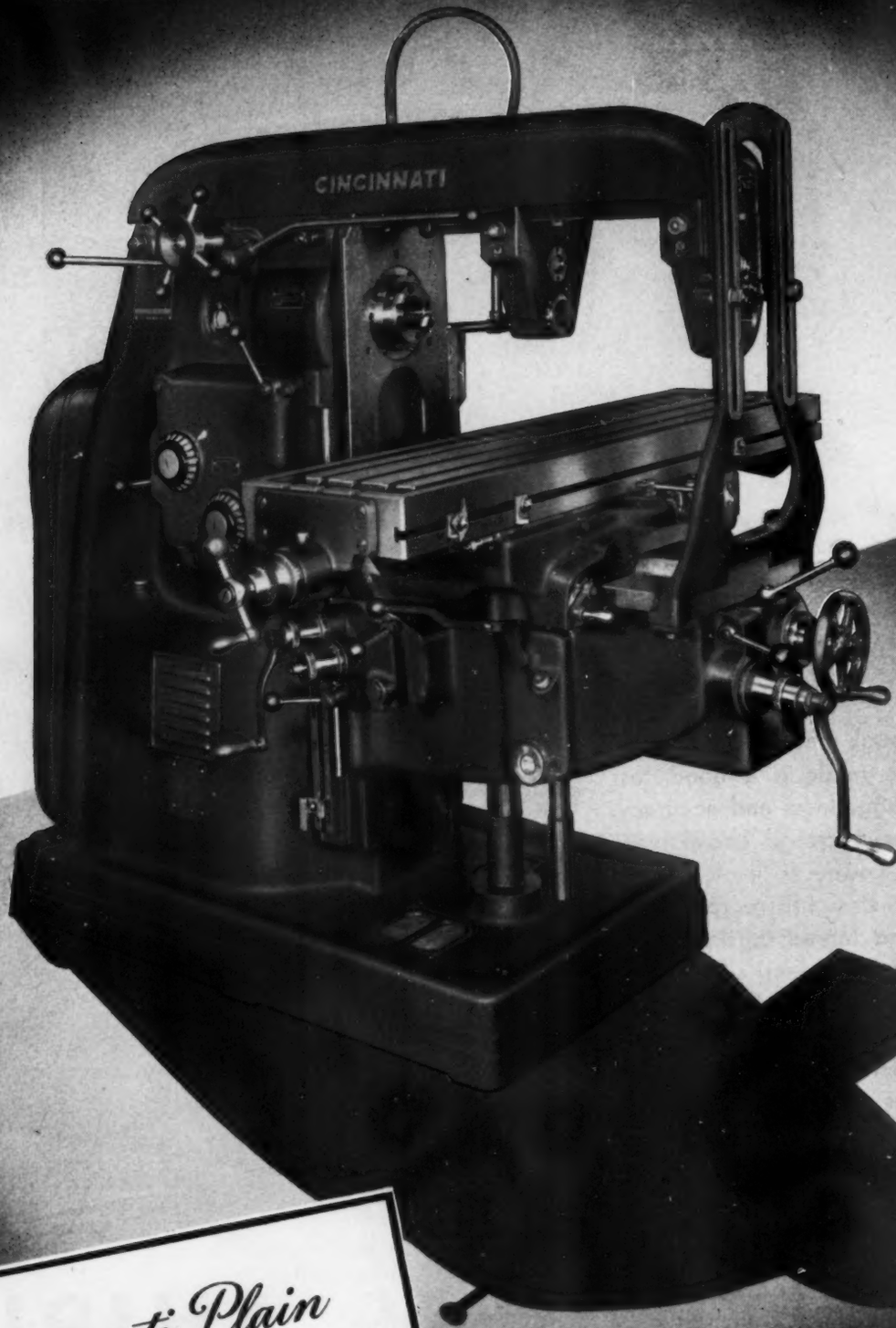
CINCINNATI, OHIO, U.S.A.

SAVE with a Cincinnati!



Cincinnati Plain
Dial Type
Milling Machine

CINCINNATI

Shorten Your Production Time

CINCINNATI Dial Type Milling Machines offer unlimited possibilities for more economical milling, and are successfully meeting the demand for "more production, faster." See them in action on a multiplicity of milling operations, in a wide variety of materials, making heavy or delicate cuts with equal ease, operated from the front or rear by means of complete *dual controls*, with speeds and feeds selected instantly, by power. You will be convinced that these fine milling machines are capable of greatly reducing your production time, and that they will produce far in excess of anything you ever thought possible.

Because CINCINNATI Dial Type Milling Machines are easy to handle, operators are able to turn out more work without any additional effort. You'll find there's no production lag toward the end of the shift. This means greater daily production, an accomplishment in which you are vitally interested. CINCINNATI Dial Type Milling Machines have a habit of moving your production calendar ahead.

They are available in Plain, Universal and Vertical styles, in three sizes, Nos. 2, 3, 4, and in either of two speed ranges, Medium or High. Specification folder M-970 covering all features and their benefits will be sent on request.

THE CINCINNATI MILLING MACHINE CO.

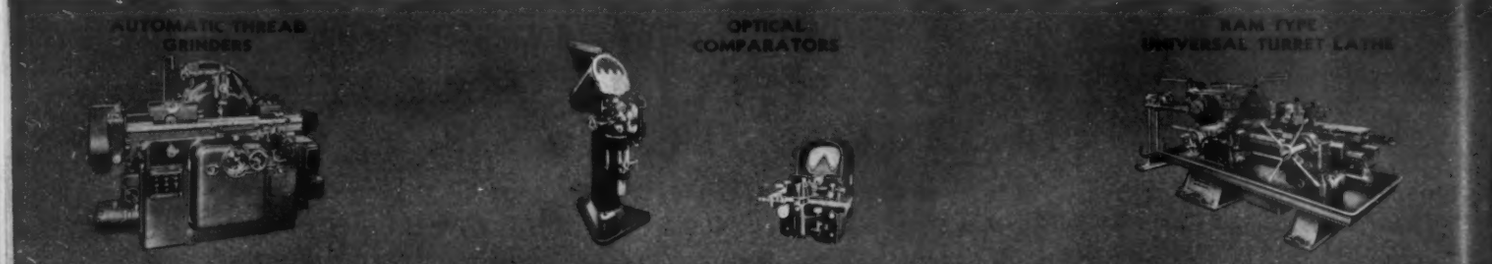
Cincinnati, Ohio U. S. A.

TOOL ROOM AND MANUFACTURING MILLING MACHINES
SURFACE BROACHING MACHINES • CUTTER SHARPENING MACHINES

ASAHEL HUBBARD

In 1835 Asahel Hubbard rode home astride a fine white horse. The horse was a gift from grateful citizens of St. Louis, where Mr. Hubbard had installed a rotary pump to assure the first continuous supply of water to the town. This pump he had transported more than a thousand miles by raft and ox cart, after designing and building it in the Vermont shop, of which today's Jones & Lamson Machine Company is a direct successor.

Jones & Lamson Automatic Thread Grinder Model TG-615



did a job for YOU !

MOST people never heard of Asahel Hubbard. The machines he built no longer run, but in building them he did a job for you. He pioneered advances in engineering, management and precision workmanship that industry takes for granted today. And so did many other men, like Hedge, Kendall, Lawrence, Howe and Hartness whose labors marked the progress of this company and its predecessors.

Today Jones & Lamson engineering is *continuing, broadening and speeding up* a progress which long ago began—*and which has never stopped.*

That is why modern Jones & Lamson machine tool technique is ready to meet today's emergency and help you safeguard profits in tomorrow's competition.

That is why it pays to put production problems up to Jones & Lamson engineers. Inquiries from large companies or small receive prompt, complete and careful study here.

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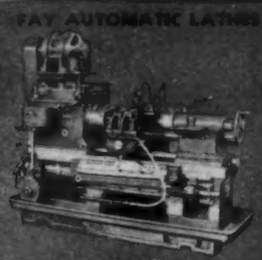

PROFIT PRODUCING
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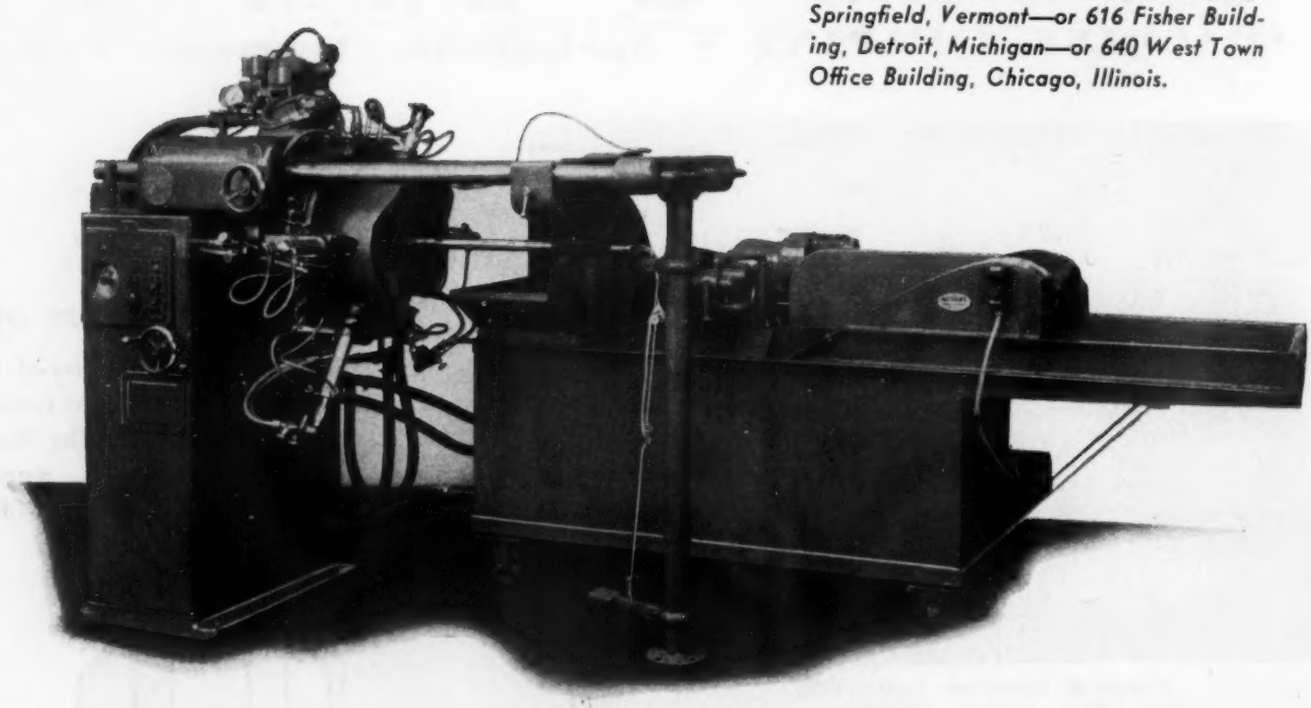
Fellows Flame Hard e

IS CAPABLE OF *Wide*

Torches are adjustable for any desired position relative to the work being heated . . . Set-up time is seldom more than 30 minutes, even when changing over for widely different parts . . . Heating is electric time-switch controlled, assuring uniform results throughout an entire production run . . . Distortion is so minimized that "after-machining" operations are eliminated, and costs greatly reduced . . . Push button starting, automatic stop and automatic ejection of work for transfer to cooling tank make for high speed output.

★ *For more complete details write for your copy of our new Flame Hardener Bulletin. The Fellows Gear Shaper Company, Springfield, Vermont—or 616 Fisher Building, Detroit, Michigan—or 640 West Town Office Building, Chicago, Illinois.*

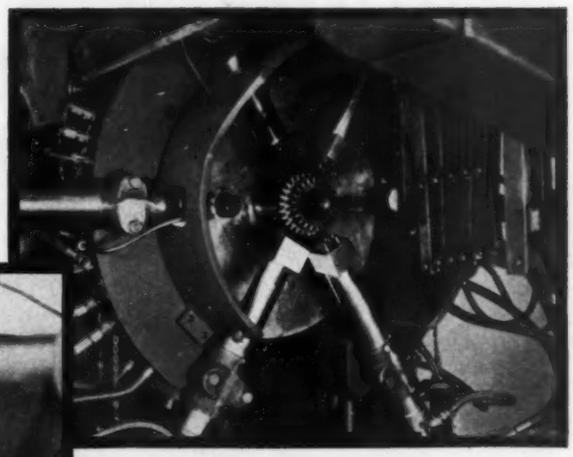


FELLOWS

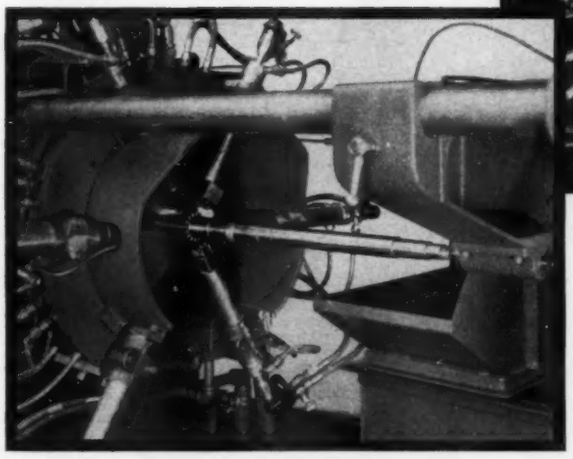
MACHINES AND TOOLS FOR GEAR PRODUCTION

ening

Application



CIRCULAR PARTS UP TO 10½-inches dia



SHAFTS UP TO 36-inches in length

For gears and similar parts, the flame area can be of any desired width up to 2-inches on large-diameter parts, and 4-inches width where diameter is 4 inches or less.

Heating can be localized at any point along a shaft, and to the same lengths as specified above. Heating distortion is reduced to the absolute minimum.

FELLOWS FLAME HARDENING PAYS DIVIDENDS IN THE "AFTER-MACHINING" IT ELIMINATES. IT IS A COST-SAVING PROCESS WORTHY OF YOUR INVESTIGATION.

Method

. . . . FROM BLANK TO FINISHED GEAR

CINCINNATI

SAVE *with a Cincinnati!*

least OF OUR MAINTENANCE WORRIES is this

CINCINNATI HYDRAULIC UNIVERSAL GRINDING MACHINE

One of the most important benefits accruing to users of CINCINNATI 12" Hydraulic Universal Grinding Machines is the low cost of maintenance. With a CINCINNATI Hydraulic Universal you may be sure of continuous operation because there will be very little lost time in making repairs. Here are a few of the maintenance cost-cutting features built into the CINCINNATI Hydraulic Universal Grinding Machine.

● FILMATIC Spindle Bearings, exclusive with CINCINNATI Grinding Machines, have eliminated the difficulties in what has always been the most troublesome element — the spindle bearings. There's no adjusting and rescraping with FILMATIC Spindle Bearings. ● Tableways are pressure lubricated and completely covered with telescoping ways to prevent entrance of coolant and grit. This not only saves wear, thus adding to the life of the machine, but prolongs and preserves its accuracy. ● Every power operated mechanism is either pressure lubricated or completely submerged in oil. ● Built-in leveling jacks make it easy to keep the CINCINNATI Hydraulic Universal always level.

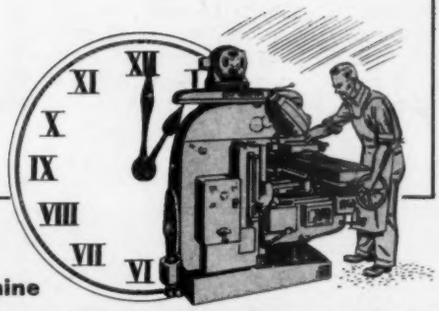
No detail has been overlooked to make the CINCINNATI 12" Hydraulic Universal the finest toolroom grinding machine manufactured . . . a grinder in which maintenance has been practically eliminated. Get all the facts. Send for "Better Grinding in Your Toolroom" covering all features and their benefits.

CINCINNATI GRINDERS INCORPORATED

Cincinnati, Ohio U. S. A.

CENTER TYPE GRINDING MACHINES • CENTERLESS GRINDING MACHINES
CENTERLESS LAPPING MACHINES

MORE WORK PER MAN-HOUR . . .

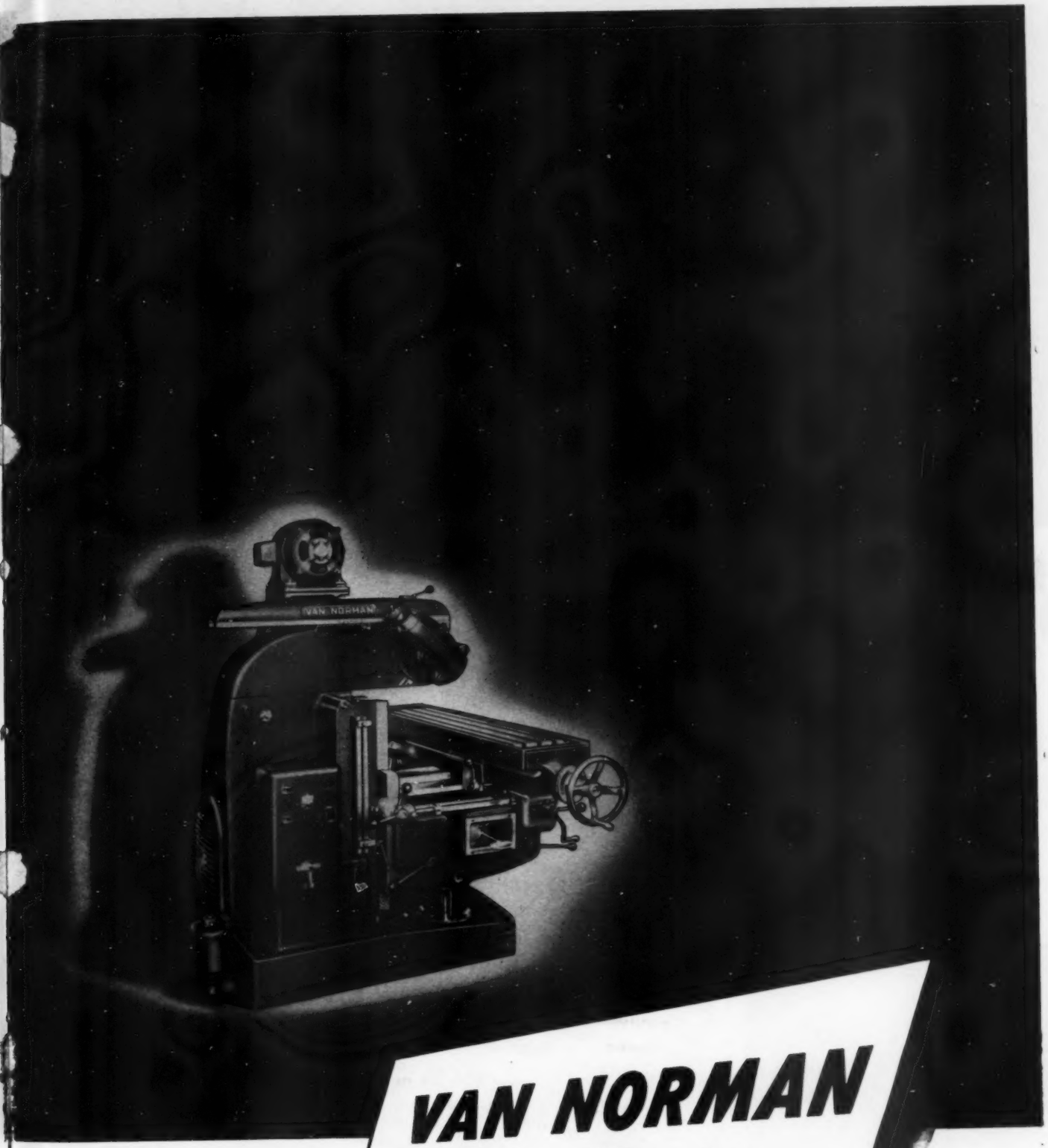


As one authority puts it: "You don't buy a machine tool so much as you buy results — the greatest number of pieces per hour, produced with highest accuracy." And this is exactly what you get in every one of the five models of Van Norman Ram Type Millers. Your operators can turn out more and better work because they have so much less preliminary, error-charged, fussing to do . . . because it is so much easier to set up these machines . . . and to control them when they are in operation. Set-up time is saved by combining the adjustments of cutterhead and ram to take successive cuts from horizontal to vertical.

Control is simplified by grouping the levers, governing direction of power feeds and of 6-way rapid traverse, right at operator's fingertips on both sides of the machine . . . and by giving him large dials for easy, accurate reading. And accuracy is underwritten by Van Norman's 50-year tradition of high-precision manufacturing . . . by full measure of quality in every mechanical feature, including ample weight and rigidity for smooth operation on heavy cuts. That's why . . . when you buy a Van Norman Universal . . . you buy results.

No. 26 & No. 36
RAM TYPE UNIVERSAL
Table: 50" x 12"
Range: 28" longitudinal, 12" cross, 18" vertical
(No. 36 Table: 58" x 13")

VAN NORMAN MACHINE TOOL COMPANY



VAN NORMAN
Milling Machines

SPRINGFIELD, MASS.

APACEMAKER IN COST CUTTING

...by making a saving of 42%

An average saving of 42% over previous methods is being made with an "AMERICAN" Multi-Production Lathe.

Such an outstanding record of cost-cutting would be entirely out of the question were it not for the fact that this lathe has every modern convenience for operation and measuring as well as the power, balance, ruggedness and stamina to perform at top speed using cemented carbide tools under heavy cuts and fast feeds.

"AMERICAN" PACEMAKERS are PROFIT MAKERS in many shops. Their savings are a matter of record. Ask us to send you some interesting cost data to help you compare what you are now doing with what you could do with an "AMERICAN."

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RADIALS
SHAPERS

THE AMERICAN TOOL WORKS CO.,

CINCINNATI • OHIO

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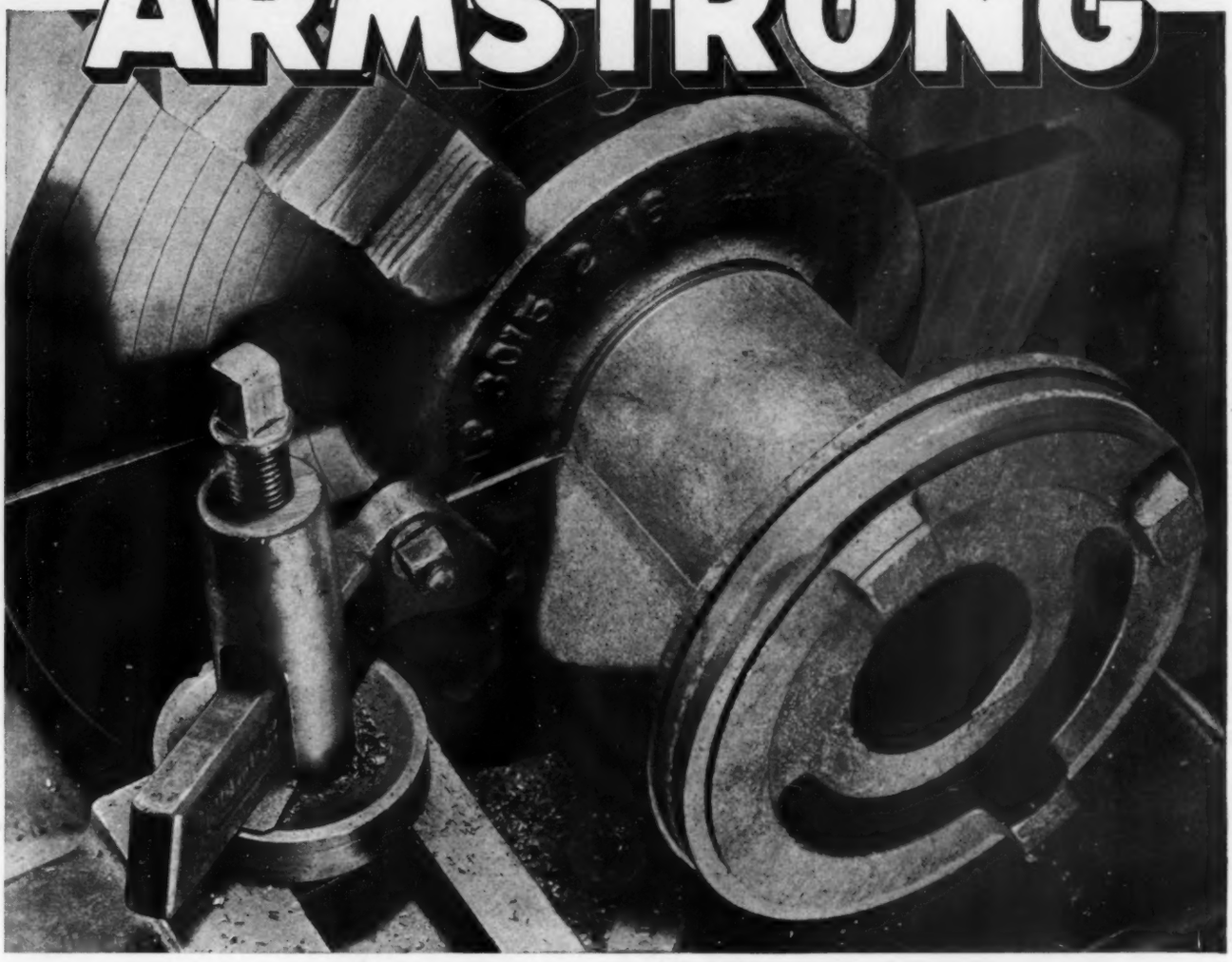


Extra strength and adjustability solves unusual machining problems

Every ARMSTRONG TOOL HOLDER has strength beyond all normal need: strength to stand up to any machine tool speed or feed; strength to do unusual operations as well as standard work. Each is a permanent, multi-purpose tool that reduces tooling-up to the selection of a cutter bit blade, adjusting for clearance and tightening of a set screw.

Take the job illustrated above . . . a special production job; a tool with extreme clearance, narrow enough to reach in between the high boss and the wide flange of the steel casting, and still strong and rigid enough to machine an accurate groove.

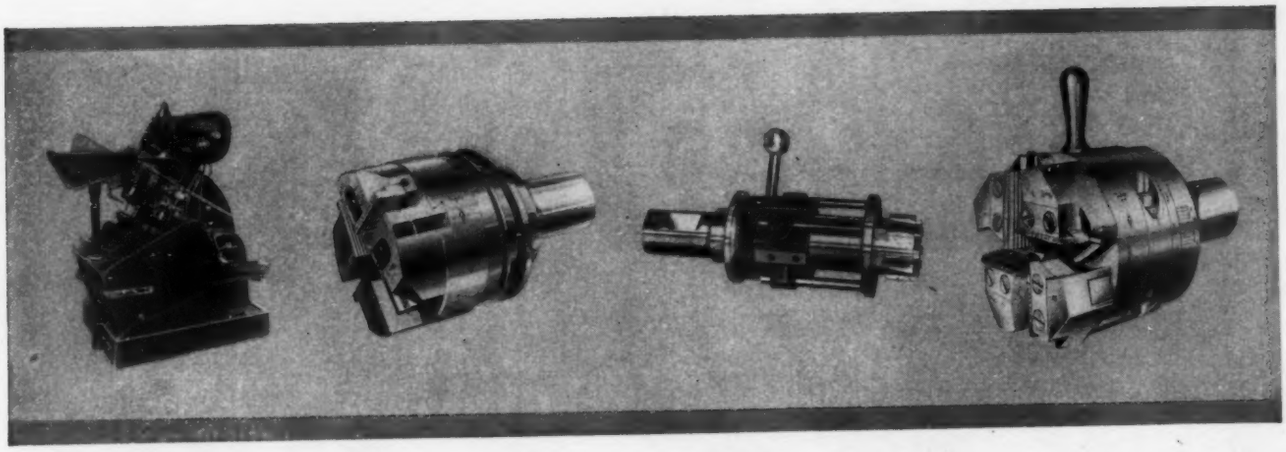
Without ARMSTRONG TOOL HOLDERS this would have presented a definite tool problem with attendant delays and interruptions of production. With ARMSTRONG TOOL HOLDERS it required but a moment to select the "right" tool holder for the specific operation. In this case it was an ARMSTRONG Right Hand Off-set Cutting-Off Tool which with blade extremely extended, provides the complete answer.

The ARMSTRONG System of Tool Holder provides instant "answer" for all operations on lathes, planers, slotters and shapers.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
315 N. FRANCISCO AVE. CHICAGO, U. S. A.

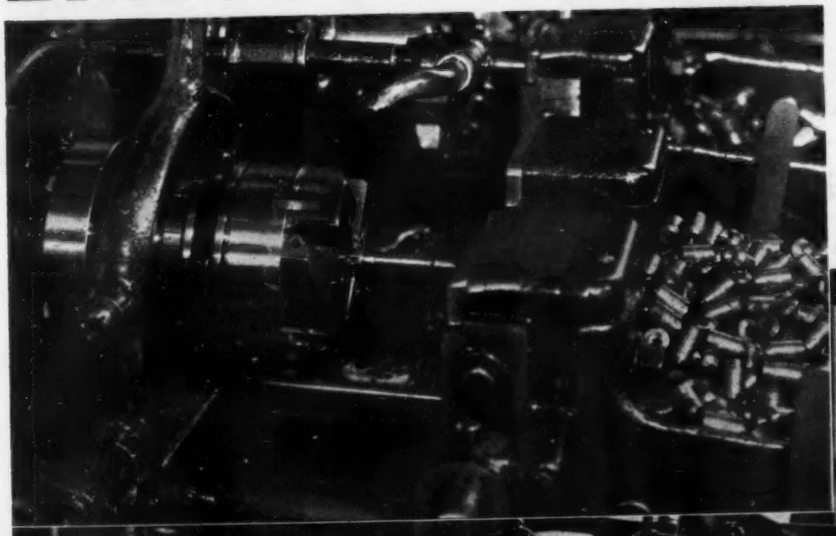
Eastern Warehouse and Sales:
199 Lafayette St., New York

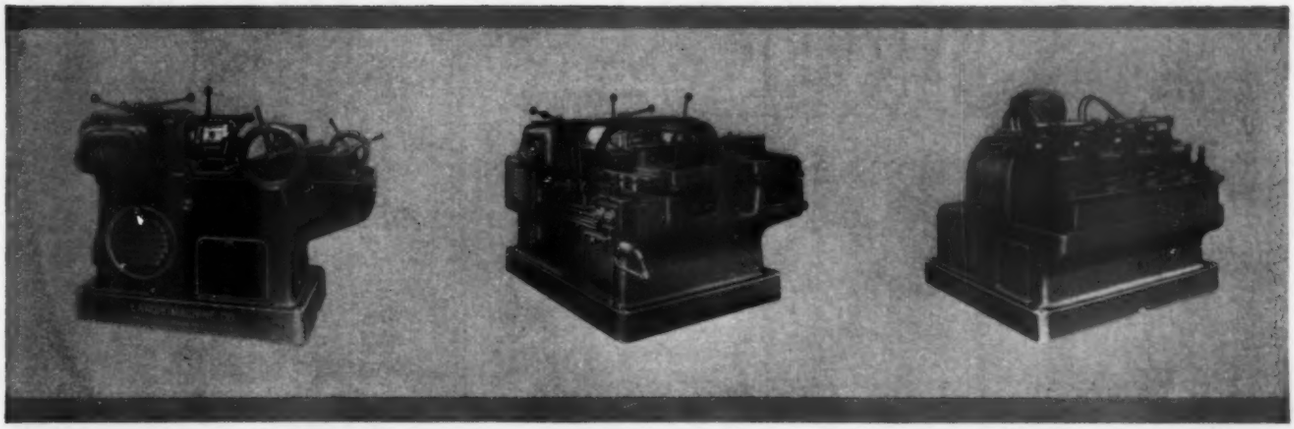
ARMSTRONG TOOL HOLDERS Are Used in Over 96% of the Machine Shops and Tool Rooms



LANCO Heads Assure

BE THREADWISE
LANDISize for Higher Production at Lower Cost





Low Threading Cost

The set screws which are threaded on the LANDMACO Threading Machine equipped with LANCO type V Heads, illustrated—range from 1/4" diameter to 1 1/4" diameter. The screws are all made from 3140 S.A.E. coldworked bar steel.

Threading at a cutting speed which ranges from 72 R.P.M. to 392 R.P.M., depending upon the diameter which is being threaded, an average of 250 screws, Class No. 3 fit, are threaded per hour. The average run between grinds of the chasers is 10,000 screws.

Such performance leaves but one conclusion—THREADING Cost must be low.

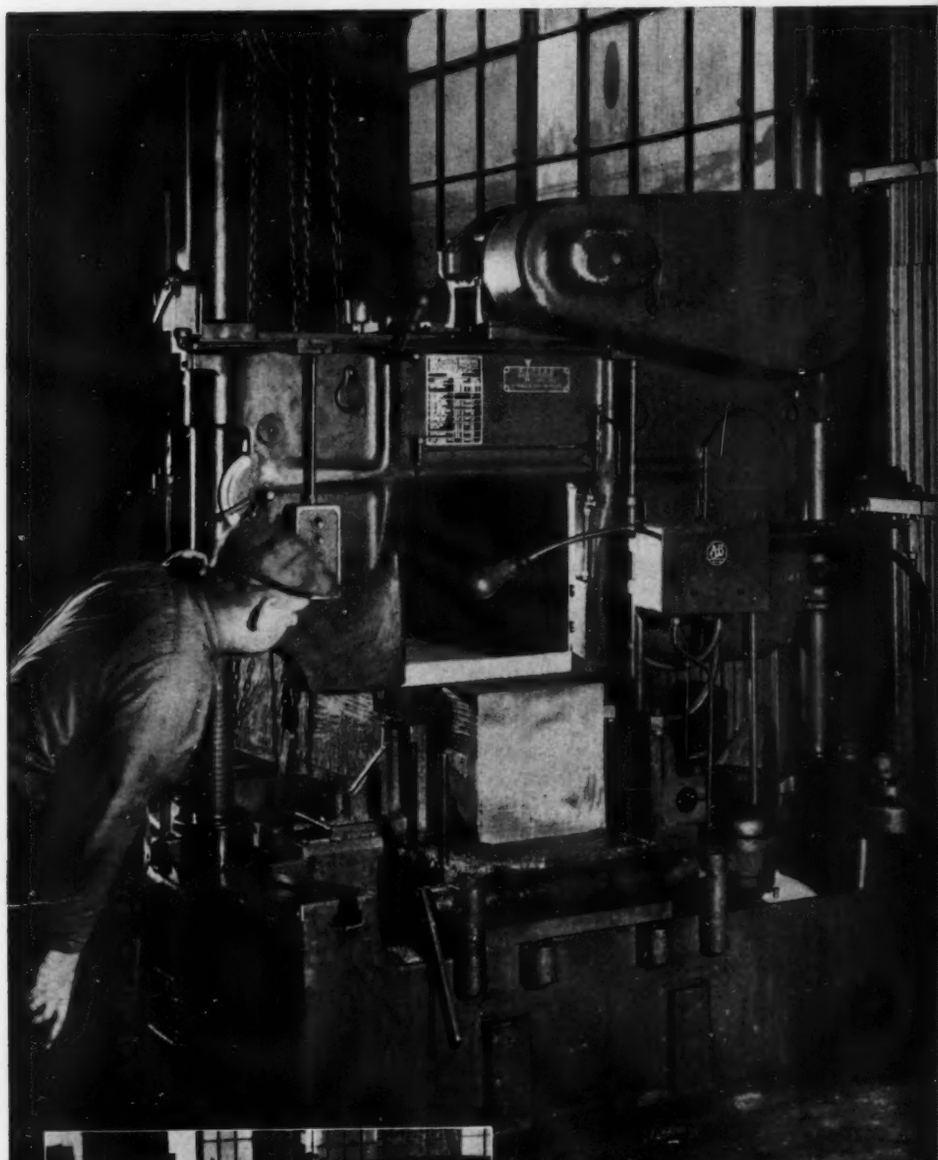
Investigate the advantages of using LANCO Heads for handling your threading operations. Write for our Bulletin No. F-80 today.

The LANDIS Line

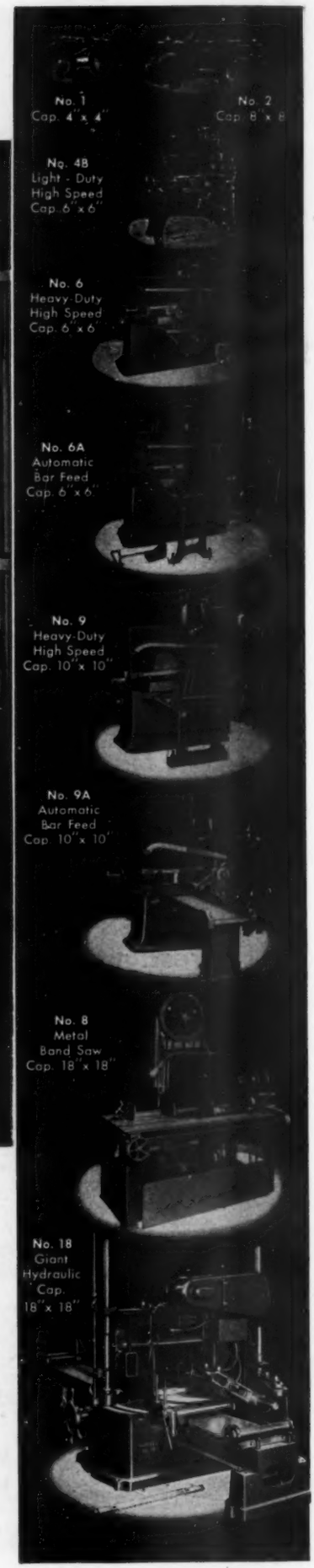
- STANDARD THREADING MACHINES
- LANDMACO THREADING MACHINES
- BOLT FACTORY THREADERS
- AUTOMATIC FORMING AND THREADING MACHINES
- PIPE THREADING AND CUTTING MACHINES
- PIPE AND NIPPLE THREADING MACHINES
- ROLLER PIPE CUTTERS
- CHASER GRINDERS
- ROTARY BOLT THREADING DIE HEADS
- STATIONARY PIPE DIE HEADS
- LANDMATIC HEADS FOR TURRET LATHES
- LANDEX HEADS FOR AUTOMATIC SCREW MACHINES
- LANCO HEADS FOR HAND-OPERATED THREADING MACHINES
- LANDIS COLLAPSIBLE AND ADJUSTABLE TAPS

LANDIS MACHINE COMPANY, Waynesboro Pennsylvania

MARVEL SAWS



Photographed at Charles E. Larson & Sons, Inc., Chicago



● **A MARVEL No. 18 giant Hydraulic Hack Saw for the big jobs, and a pair of MARVEL 9A Automatics for exceptional speed, answer all the cutting-off problems of Charles E. Larson & Sons, Inc., Chicago.**

It takes a lot of cutting-off to keep up with the rows of great hammers in this large modern, fully equipped forge plant, but it's for just such heavy-duty, high speed, continuous operation that these all-ball-bearing MARVEL SAWS were designed.

Whatever your metal sawing problems, there are MARVEL Saws exactly suited to your needs. The local MARVEL Sawing Engineer will call upon request, study your metal-cutting problems and make recommendations as to cutting-off methods, equipment and costs.

ARMSTRONG - BLUM MFG. COMPANY

"The Hack Saw People"

5700 Bloomingdale Ave., Chicago, U. S. A. Eastern Sales: 225 Lafayette St., New York, N. Y.

ONE PRICE TO ALL

Pay No Bonus for Quick Delivery of South Bend Lathes

YOU need not and should not pay a premium price in order to get quick delivery of a South Bend Lathe. All orders for South Bend Lathes are filled in accordance with the policies and regulations of the Office of Production Management in Washington, D. C. The payment of a bonus or premium or any other arrangement cannot affect the delivery of a lathe from the factory, and no authorized South Bend Lathe dealer will ask more than the established price, regardless of delivery.

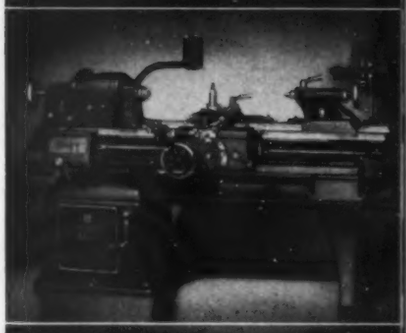
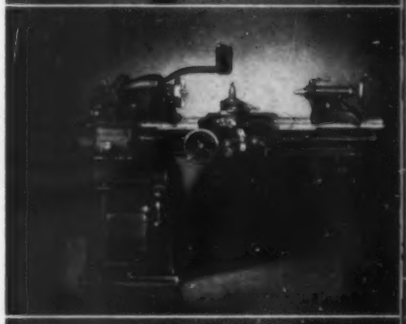
Prices of South Bend Lathes are published in our price list No. 49-A dated Jan. 10, 1941. These prices are net to the purchaser f.o.b. South Bend, Ind. The are fair and reasonable, and you should pay no surcharge, premium or mark-up of any kind, other than actual transportation charges to your city.

When you deal with an authorized South Bend Lathe distributor these are the prices you are asked to pay—no more, no less. If any other dealer offers you a South Bend Lathe at a higher price for immediate delivery, it is not in accordance with any policy established by us. We will appreciate your reporting all such proposals to us for investigation.

Authorized South Bend Lathe Dealers in the United States

Albany, N. Y......Sager-Spuck Supply Co., Inc.
Atlanta, Ga......Chandler Machinery Co.
Baltimore, Md......Carey Mchy. & Supply Co.
Birmingham, Ala......Young & Vann Supply Co.
Boston, Mass......South Bend Lathe Works*
Bridgeport, Conn......A. C. Bisgood
Buffalo, N. Y......R. C. Neal Co., Inc.
Charleston, S. C......Cameron & Barkley Co.
Charleston, W. Va......Baldwin Supply Co.
Charlotte, N. C......Glasgow-Allison Co.
Chattanooga, Tenn.....Strahle-Johnson Supply Co.
Chicago, Ill......H. J. Volz Machinery Co.
Cleveland, Ohio.....Reynolds Machinery Co.
Columbia, S. C......Columbia Supply Co.
Columbus, Ohio.....E. W. Smith Machinery Co.
Dallas, Texas.....Briggs-Weaver Machinery Co.
Dayton, Ohio.....C. H. Gosiger Machinery Co.
Denver, Col......M. L. Foss, Inc.
Des Moines, Iowa..Iowa Machinery & Supply Co.
Detroit, Mich......Lee Machinery Co., Inc.
Duluth, Minn......W. P. & R. S. Mars Company
Elmira, N. Y......LeValley, McLeod, Kinkaid Co.
Evansville, Ind......Orr Iron Company, Inc.
Grand Rapids, Mich......Harding Machinery Co.
Greenville, S. C......Carolina Supply Co., Inc.
Hickory, N. C......Smith-Courtney Co.
Houston, Texas.....Wessendorff, Nelms & Co.
Indianapolis, Ind......Marshall & Huschart Mchy.
Jackson, Mich......Blank & Buxton Mchy. Co.
Kansas City, Mo......Faeth Company
Knoxville, Tenn......W. S. Murrian Co.
Louisville, Ky......Neill-LaVielle Supply Co.
Los Angeles, Cal......Eccles & Davies Mchy. Co.
Melbourne, Fla......William Rath
Memphis, Tenn......Lewis Supply Co.
Milwaukee, Wis......W. A. Voell Machinery Co.
Mobile, Ala......Turner Supply Co.
Moline, Ill......John J. Normoyle Co.
Muskegon, Mich...Lakeshore Mchy. & Supply Co.
Nashville, Tenn......R. H. Chilton Auto Machine
Newark, N. J......J. R. Edwards Mchy. Co.
New Orleans, La......Dixie Mill Supply Co.
New York, N. Y......A. C. Colby Machinery Co.
Oklahoma City, Okla......Hart Industrial Supply
Omaha, Nebr......Fuchs Machinery & Supply Co.
Phoenix, Ariz......Banks-Merwin Company
Philadelphia, Pa......W. B. Rapp Machinery
Pittsburgh, Pa......Tranter Manufacturing Co.
Plainville, Conn......Ideal Machinery Co.
Portland, Ore......Portland Machinery Co.
Providence, R. I......George T. Reynolds & Son
Raleigh, N. C......Dillon Supply Co.
Reading, Pa......Reading Machine & Tool Co.
Richmond, Va......Smith-Courtney Co.
Rochester, New York.....Ogden R. Adams
Rockford, Ill......Factory Supplies Co.
Springfield, Mass......Arthur H. MacBriar
St. Louis, Mo.....Colcord-Wright Mchy. & Supply
St. Paul, Minn......Robinson, Cary & Sands Co.
San Antonio, Texas.....Alamo Iron Works
Salt Lake City, Utah.....Industrial Supply Co.
San Francisco, Cal......Moore Machinery Co.
Savannah, Ga......John D. Robinson Co.
Scranton, Pa......Chas. B. Scott Co.
Seattle, Wash......Star Machinery Co.
Shreveport, La......Dixie Mill Supply Co.
Syracuse, N. Y......H. A. Smith Machinery Co.
Toledo, Ohio.....Eno Tool & Supply Co.
Wichita, Kansas.....Watkins, Incorporated
Worcester, Mass......Brierly, Lombard & Co., Inc.
York, Pa......York Machinery & Supply Co.

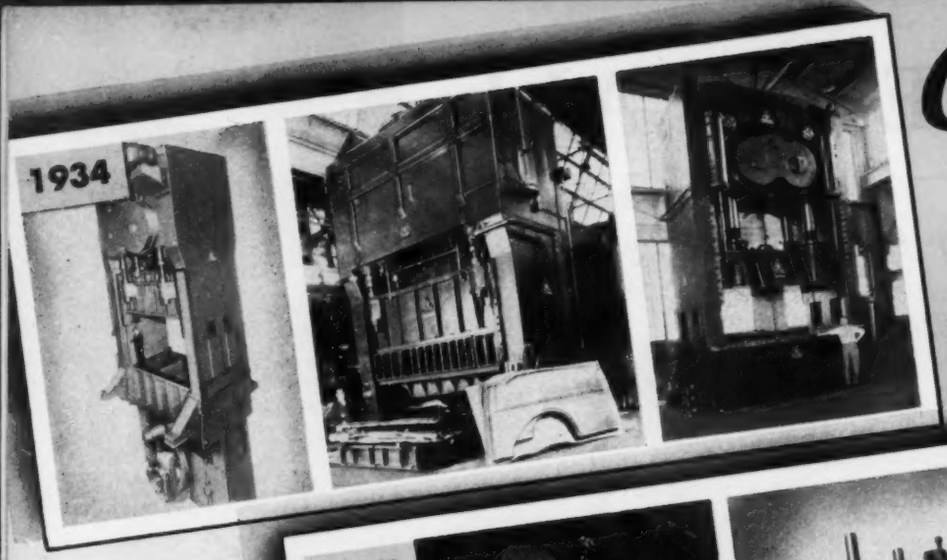
*Boston Sales Office, 67 Broadway, Kendall Square, Cambridge, Mass.
W. H. Packard, Manager - - - - - - Phone Trowbridge 6369

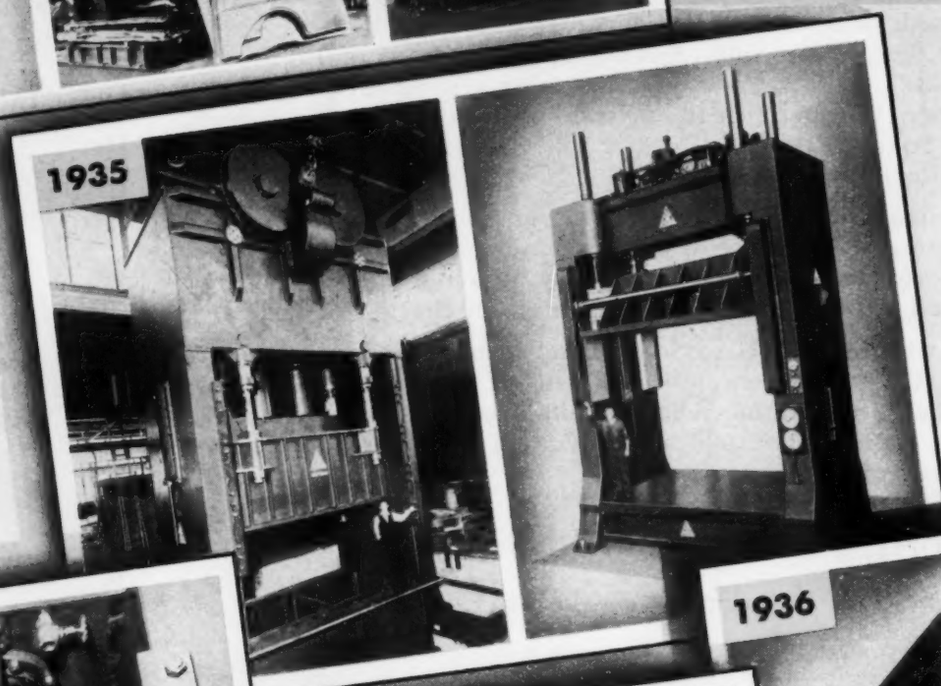



SOUTH BEND LATHE WORKS

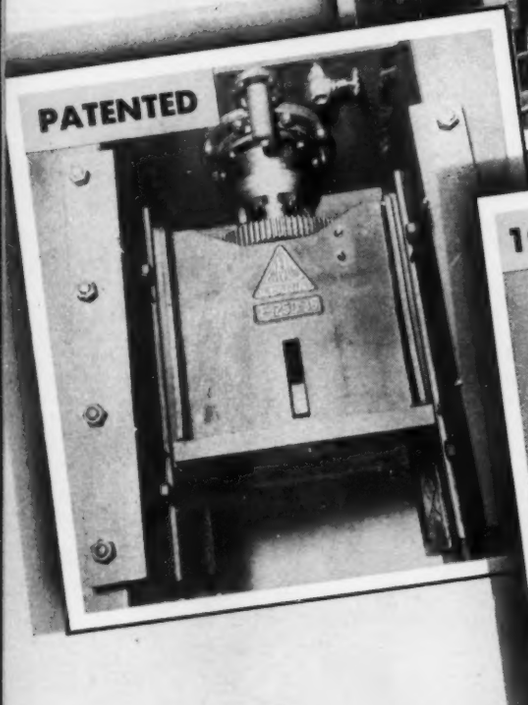
LATHE BUILDERS SINCE 1906 **227 E. Madison St., South Bend, Ind., U. S. A.**

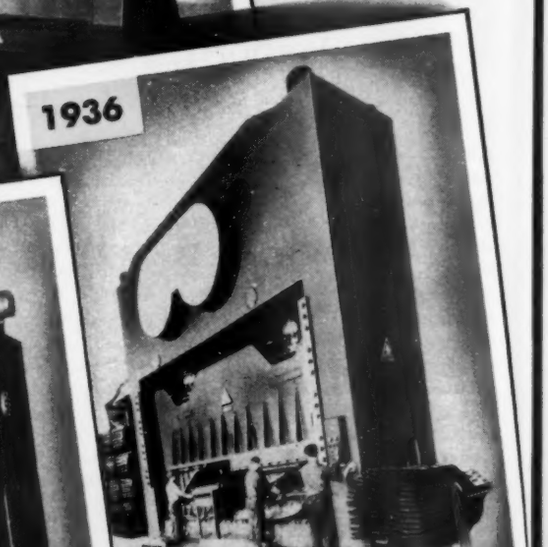
Outstanding





CMC CLEARING





1934 (1) Triple Action Crankless Press. (2) 1500-ton Triple Action, four point suspension Press. (3) 600-ton Single Action, four point suspension Press.

1935 (1) 800-ton Double Action Crankless Press. (2) Hydraulic Die Spotting Press.

1936 2600-ton Single Action, two point suspension Press.

1939 100-ton Crownless Press.

PATENTED FEATURE one, two and four point plunger guided slide suspension. Plunger guided through crown besides having bearing surfaces on four adjustable gibs.

Developments

—*in*

CLEARING PRESSES

1934-1941

On these pages are illustrated the outstanding developments in Clearing Press designs since 1934, corresponding descriptions appear on these pages. They are representative developments only—Clearing's service to Industry is so broad and all inclusive that it's impossible to illustrate *every* Clearing design. Yet these few are indicative of Clearing's superiority, of the ability to advance in step with Industry's increasing demands for better work . . . for faster production . . . for greater economies.

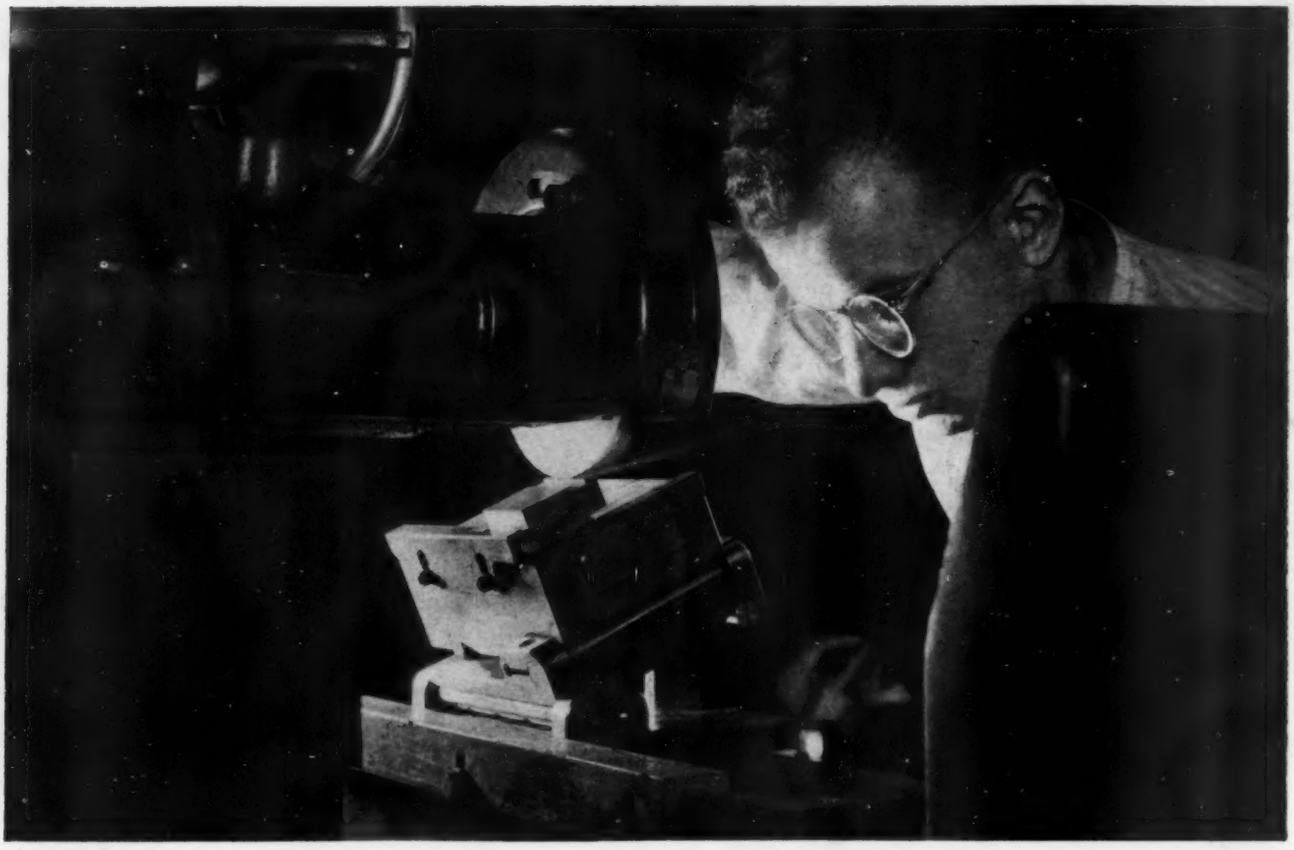
1940 (1) 1500-ton Single Action Hydraulic Press. (2) 200-ton Knuckle-joint Presses, with dial feeds. (3) 150-ton Gap Frame Press.

1941 Right—Recent model 600-ton Single Action Hydraulic Press.

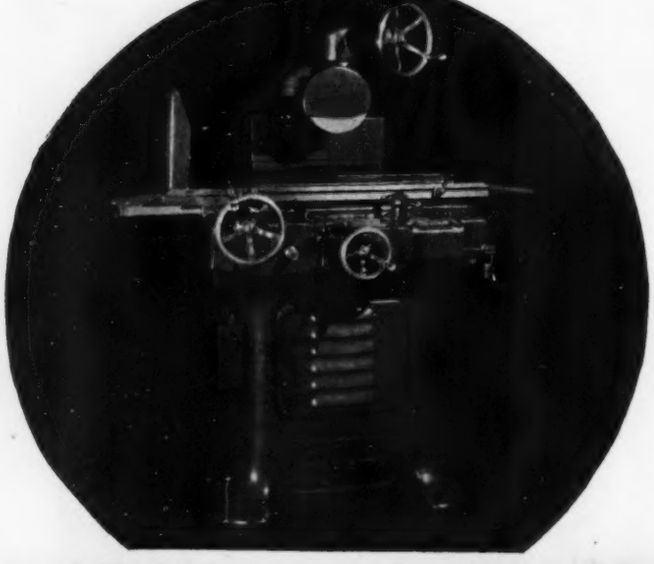
CLEARING

MACHINE CORPORATION

CHICAGO



For Fast, Accurate Grinding in the Tool Room or on Production - - - *The NORTON 6 x 18"*



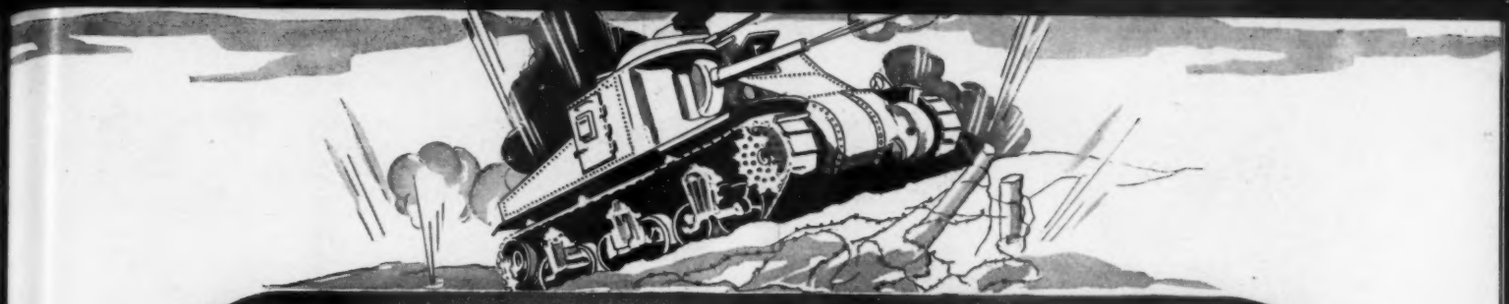
FOR those exacting flat tool and die jobs specify Norton Surface Grinders. The popular 6 x 18" machine is furnished with a plain bronze or an antifriction bearing wheel spindle—for hand or hydraulic operation—with coolant service for wet grinding or with an individual dust exhaust system. In hundreds of tool rooms as well as on the production line they are highly regarded for their accuracy, dependability and ease of operation. Send for descriptive circular No. 954. No obligation, you know.

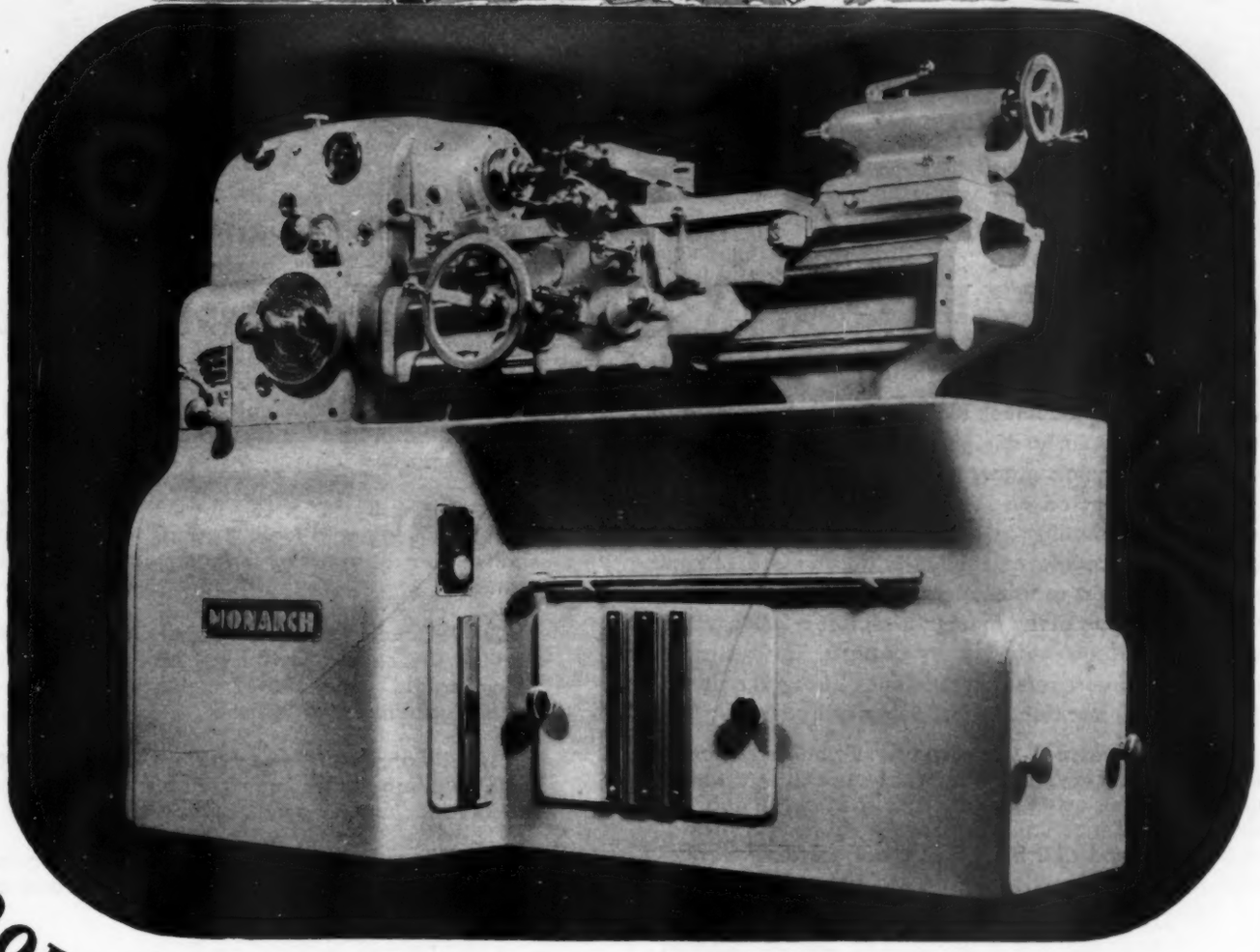
NORTON COMPANY, WORCESTER, MASS.

New York Chicago Detroit Cleveland Hartford

M-437

NORTON GRINDERS





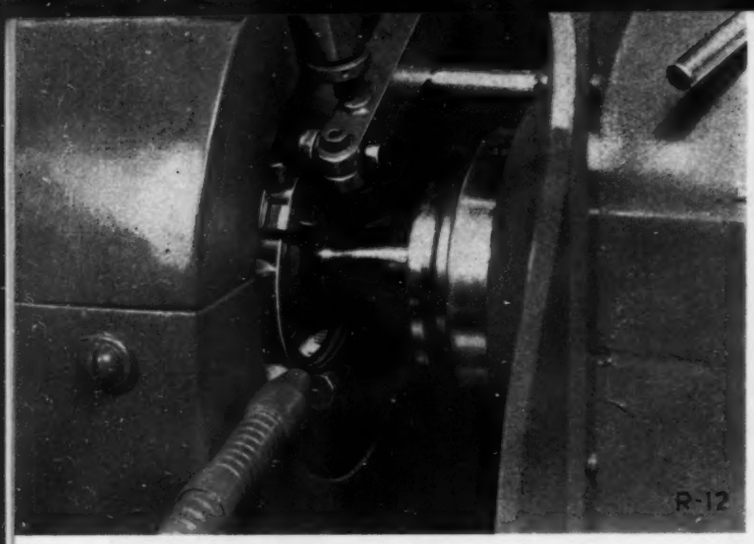
THE TOOL ROOM...

Birthplace of Uncle Sam's 28-Ton "Babies"

These mighty land battleships, the M-3 medium tanks, are now rolling off production lines to take their places in America's new mechanized forces. But, before a single tread was laid or plate drawn . . . tools, jigs and dies had to come from the nation's toolrooms.

It is in these toolrooms that hundreds of Monarch 10″ x 20″ Sensitive Precision Tool Maker's Lathes are proving their mettle under the strain of accelerated emergency production. This remarkable Monarch lathe turns, bores and faces to an accuracy of .0001″, and chases threads to lead accuracy of .0005″ in 12 inches length. (To meet the constantly growing demand for this lathe, we have doubled its production since January 1st.) THE MONARCH MACHINE TOOL COMPANY, SIDNEY, OHIO.

MONARCH LATHES



If It's VERSATILITY You Want

Some grinding machines like the Landis Hydraulic Universals are particularly designed to perform a variety of grinding operations on numerous unlike parts. Versatility in such cases is expected and is therefore not unusual. ¶ But when you find versatility in grinders designed and built for the production grinding of similar parts you are obtaining an added value in a grinder investment. Consider the views on these pages. One of the machines pictured was especially designed to handle a wide variety of parts. The rest are not ordinarily considered versatile machines but with only a few changes in equipment show surprising adaptability.

R-12:—A No. 2 Race-A-Way Grinder. Grinds both single and double row races. Internal machine handles variety of races up to and including 212, 311 and 409 sizes. External machine grinds sizes up to and including 218, 316 and 414. Shown internal grinding a raceway.

U-4:—A Landis Chucking Grinder. Grinds a wide variety of work that has to be chucked. Shown grinding a sewing machine shuttle.

Q-57:—A Landis 18" Radial Cam Grinder. With slight additional equipment grinds both straight and angular airplane cams as well as large Diesel engine cams before assembly on camshaft. Shown grinding straight face cam.

J-120:—A Landis 12" Type LC Universal. Built to external, internal and face grind a large variety of parts. Shown grinding airplane valve housing.

N-29:—A Landis 10" x 16" Type D Crank Pin Grinder. With little additional tooling grinds nine different crankshafts. Shown grinding one of nine outboard motor cranks.

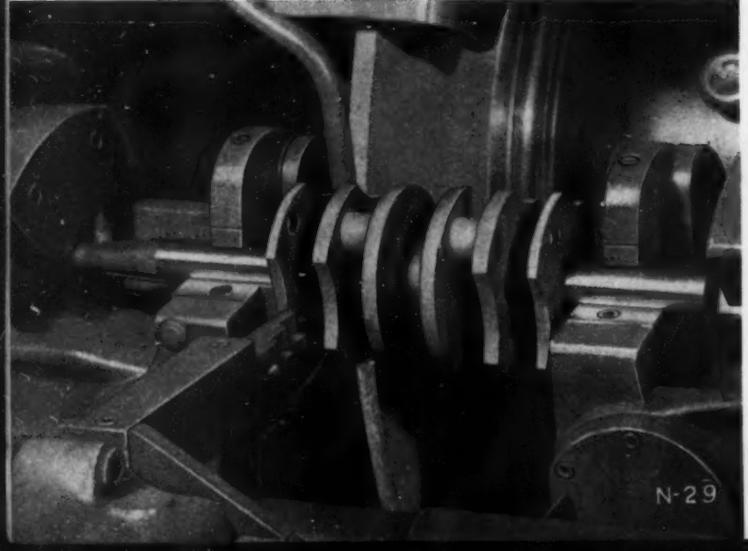
V-38:—A Landis 60" Type 30 Roll Grinder. Grinds rolls varying in size and hardness. Can be supplied to grind rolls straight, crowned or concaved; necks tapered. Shown grinding a 40 ton roll.

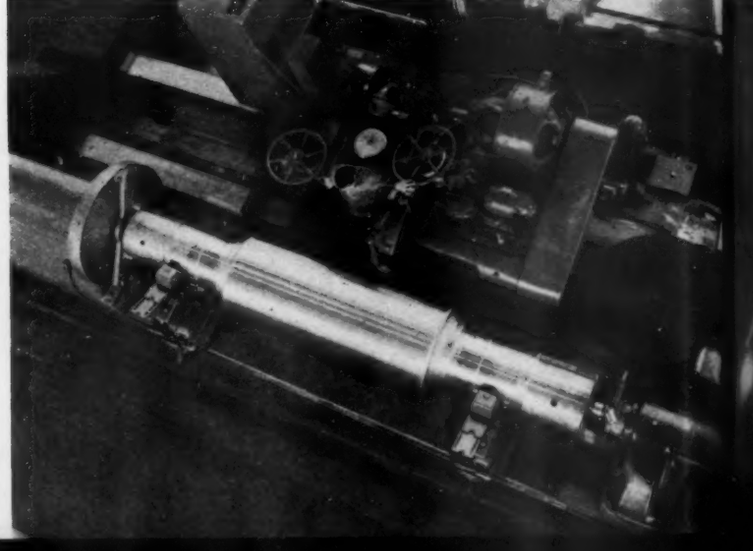
A-23:—A Landis 4" Type H Plain Grinder. Four complete grinding cycles are available making this a very flexible machine. Shown grinding a shaft.

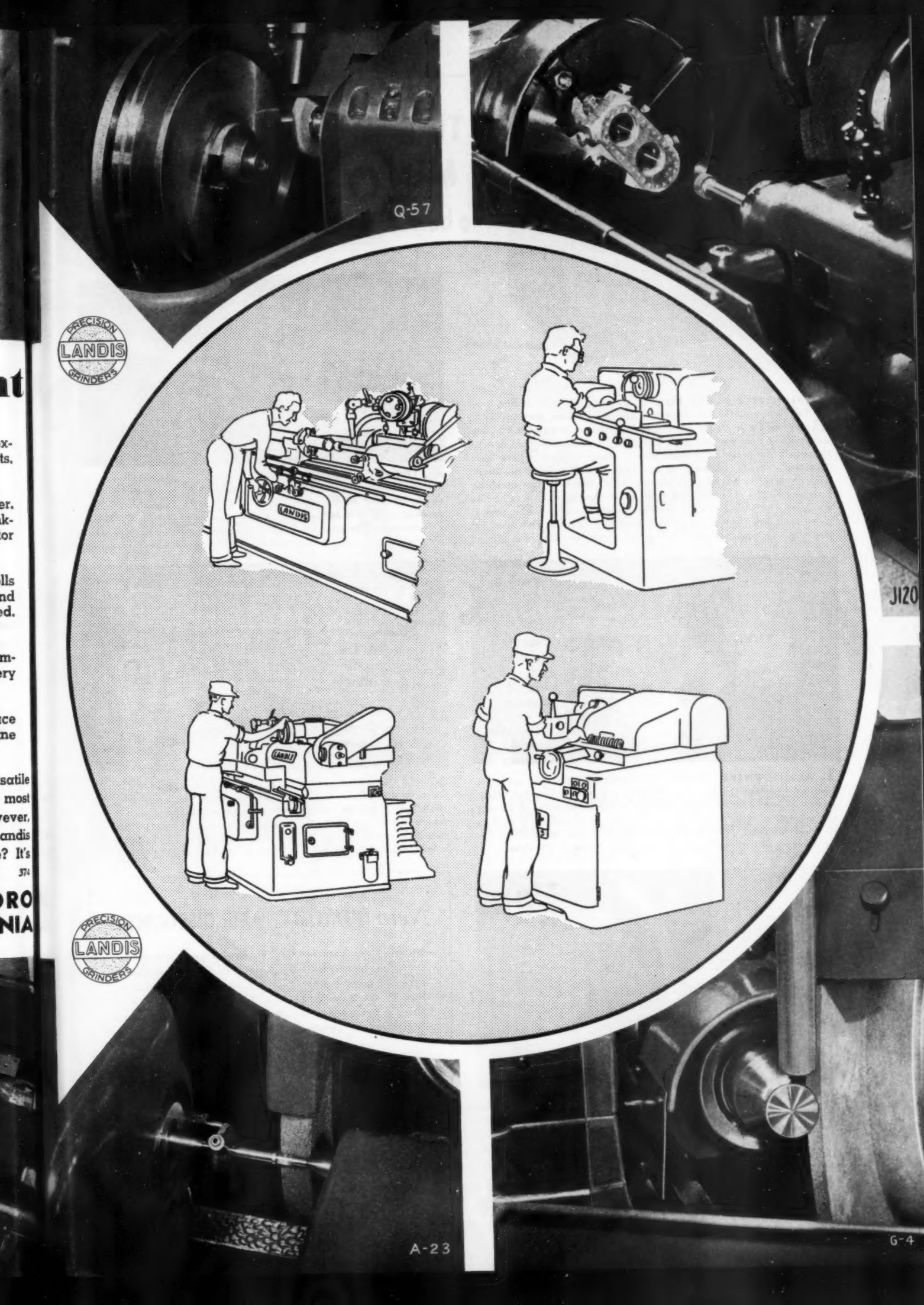
G-4:—A Landis Valve face Grinder. Will grind face and O. D. of the head of both automobile and airplane valves. Shown grinding valve face.

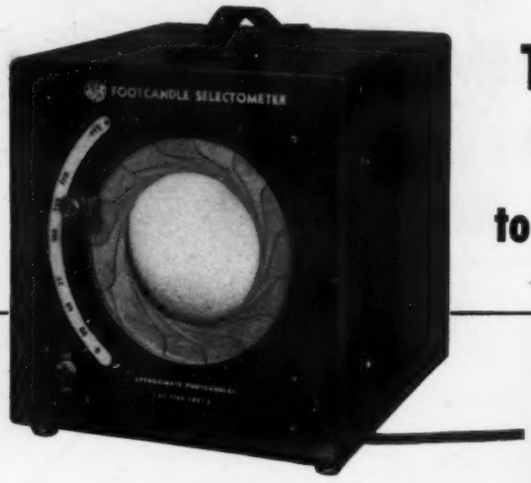
To be sure, with the exception of the naturally versatile Universal Grinder shown, these machines were for the most part built for the grinding of a specific job. Isn't it, however, to your eventual advantage to be able to use your Landis grinders for different jobs should the occasion arise? It's worth investigating. 374

LANDIS TOOL CO. WAYNESBORO PENNSYLVANIA






Q-57
PRECISION
LANDIS
GRINDERS
LANDIS
J120
PRECISION
LANDIS
GRINDERS
A-23
G-4



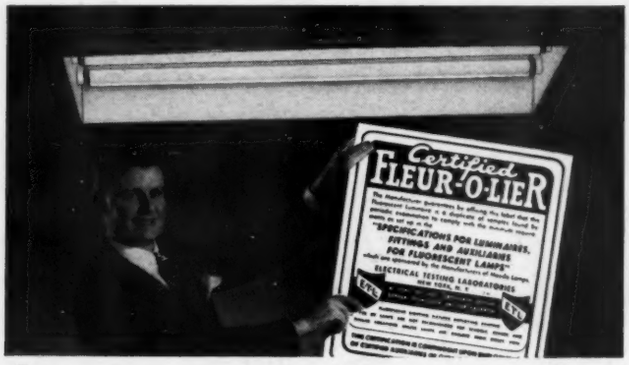
THIS LITTLE BLACK BOX MAY HOLD THE SECRET

to better production in your plant!

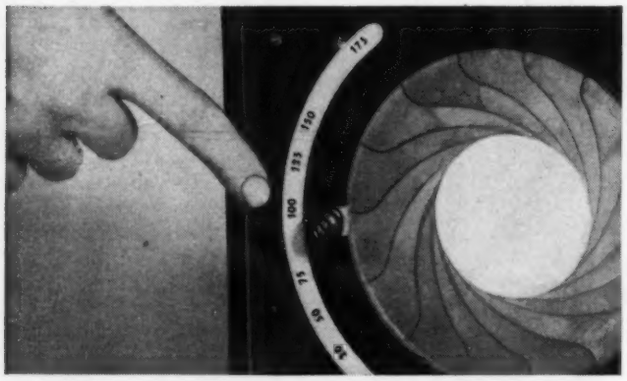
1. THIS LITTLE BLACK BOX is an amazing new device . . . the G-E Footcandle Selectometer. It isn't for sale, but any G-E lighting man will gladly show you how to use it and let you see for yourself how various amounts of light affect different operations in your plant. For example . . . take any job where fast, accurate seeing is necessary, as in operating a high-speed machine. This represents not only a sizable investment in the machine but also in the training and skill of the operator. Unless he has enough light for fast, easy seeing, he tires more quickly, makes more mistakes, and a lot of the precision value of the machine and the workman is lost. Good light is needed, but how much?

4. TODAY IT MAY SEEM impractical to provide general indoor illumination of 100 to 200 footcandles, but it is possible to get 50 to 100 footcandles with G-E MAZDA lamps . . . incandescent, mercury, or as many plants are doing, with G-E MAZDA F (fluorescent) lamps. Ask your G-E lighting man or electric service company for a G-E Footcandle Selectometer demonstration.

2. HERE'S WHERE the G-E Footcandle Selectometer makes it possible to select the amount of light you would like for easier seeing. It works on a simple principle which increases or decreases the amount of light you direct on the job . . . anywhere from 0 to 175 footcandles. After experimenting, you can tell when the light seems best to you. Let the machine operator try it too.



5. SEE YOUR G-E MAZDA LAMP DISTRIBUTOR for a wide choice of Tested-Certified-Guaranteed fixtures, complete with G-E MAZDA F lamps ready to hang up and turn on. General Electric does not make fixtures for MAZDA F lamps, but recommends Fleur-O-Lier or RLM certified fixtures. For information, write General Electric Co., Dpt. 166-AC-F, Nela Park, Cleveland, O.



3. TAKE A CLOSE LOOK at the footcandle reading on the dial. 90 footcandles? That's the amount of light your eyes said they wanted for that particular job. It may be two, three, or ten times the amount of light regularly used at that machine. But it is the amount of light that your eyes prefer.

New QUANTITY LAMP DISCOUNTS

Quantity purchasers of G-E MAZDA lamps . . . incandescent, fluorescent, mercury, or any of the thousands of types of large lamps that G. E. makes . . . can now buy $5 worth for $4, $15 worth for $11.25. In addition, there are new larger discounts for contract purchasers. See your G-E MAZDA lamp supplier today!

G-E MAZDA LAMPS

GENERAL ELECTRIC

Made to stay brighter longer

TURRETS that save *Manpower* and *Minutes!*

In this rearmament race of manpower against minutes, new Gisholt Turret Lathes are attacking their objectives with greater efficiency than ever before—with the speed and accuracy that saves 40%, 50% and 60% over the machines of only a few years ago.

Savings like these can't be ignored. You need them now! And you'll need them in the highly competitive years ahead.

You can avoid penalties to your business by modernizing your equipment on a systematic plan. It's a good time to discuss these matters with a Gisholt engineer.

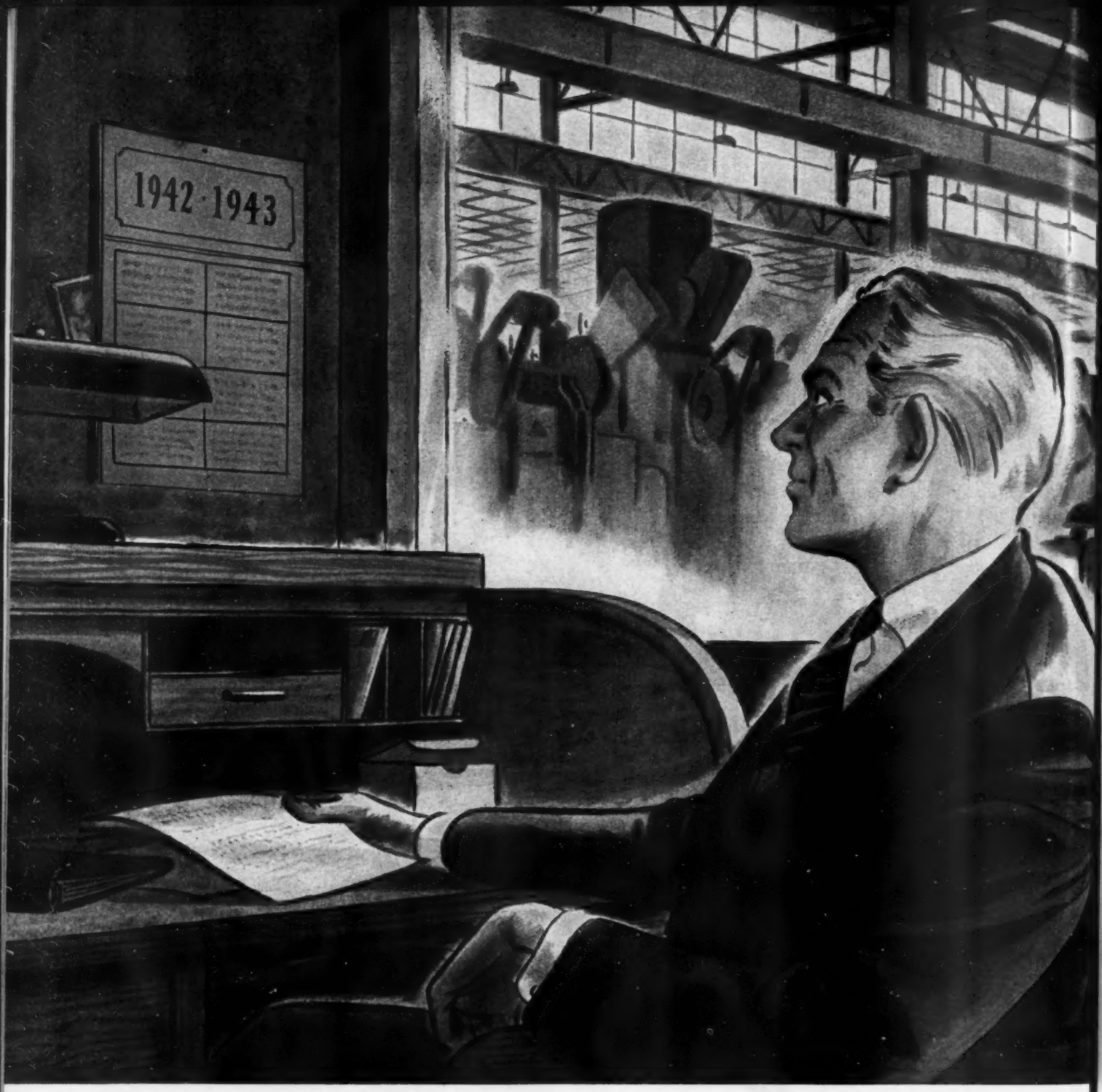
Look ahead . . . keep ahead . . . with Gisholt improvements in metal turning

GISHOLT

GISHOLT MACHINE COMPANY

1201 EAST WASHINGTON AVENUE • MADISON, WISCONSIN

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES



WHEN A FORWARD GLANCE MAY SAVE A BACKWARD STEP

● When times are good, and business is booming — that's just the time to pause and give a thought to tomorrow. Living in the present and letting tomorrow take care of itself is never a profitable preoccupation. Today's business activity is taking place in a sellers' market.

Selling tomorrow, however, will be an all-out, buyers' market battle, with market places bristling with better merchandise at lower prices. And the one positive way to assure yourself of good business in such a market is to plan now to turn to LeBlond Lathes for all your turning requirements.

Should you require assistance in planning future lathe purchases we are at your service. We will be glad to furnish you upon request any data you may require. Simply address Dept. H-3.

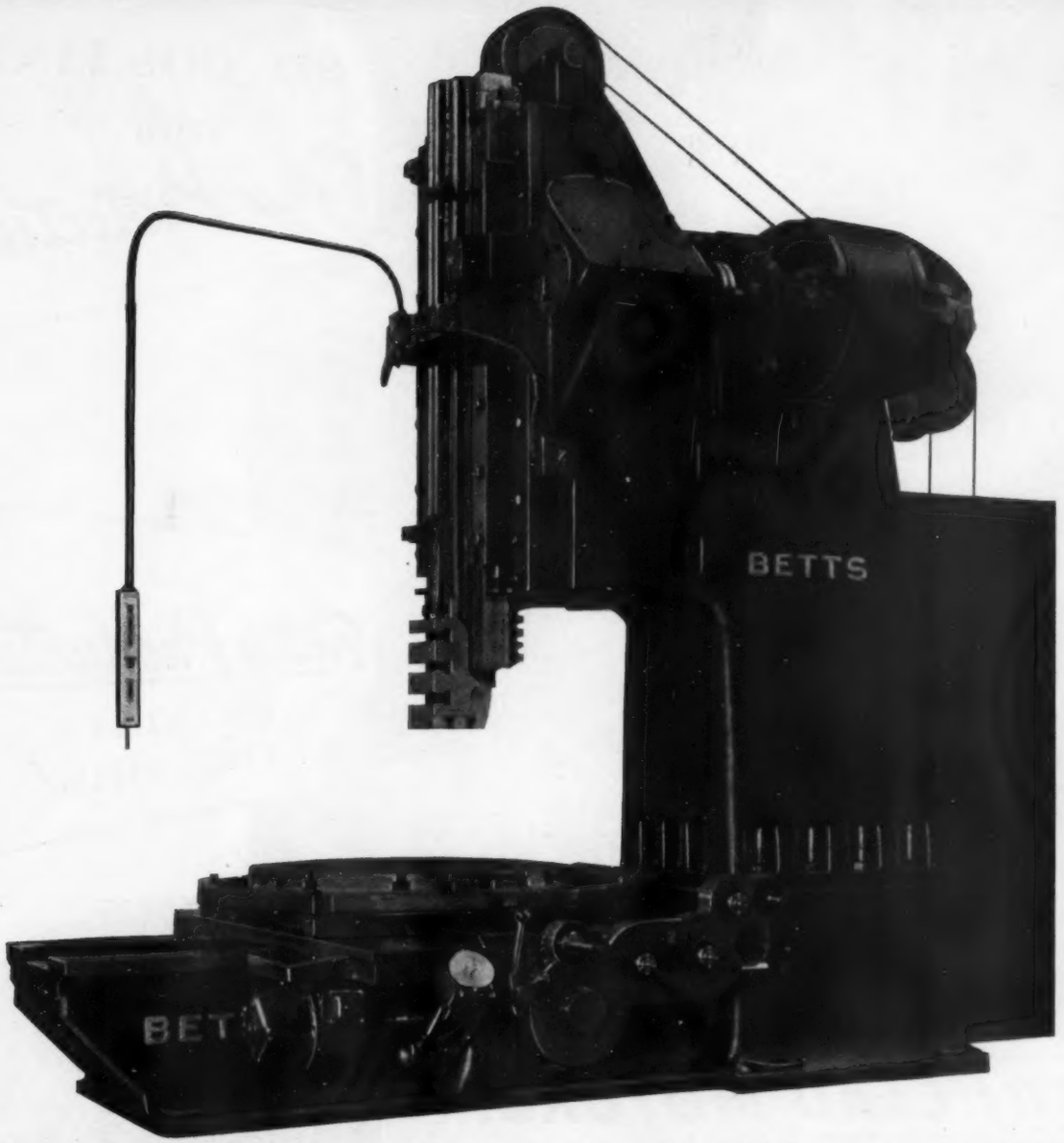
THE R. K. LEBLOND MACHINE TOOL CO., CINCINNATI, OHIO, U.S.A.

Chicago: **20 N. Wacker Drive**
Phone: STA 5561

LEBLOND CINCINNATI OHIO U.S.A.

New York: **103 Lafayette St.**
Phone: Canal 6-5281

Where SLOTTING is a Major Operation You Can Depend on BETTS



When your slotting jobs are big jobs and require a high degree of accuracy, too, you need a BETTS Worm and Rack Driven Slotter. And you will find that this accuracy and ability to do your tough jobs is not gained at the sacrifice of productivity.

BETTS Heavy Duty Slotters have all the rigidity required to do the tough jobs and at the same time they handle easily and conveniently because of expert design and workmanship.

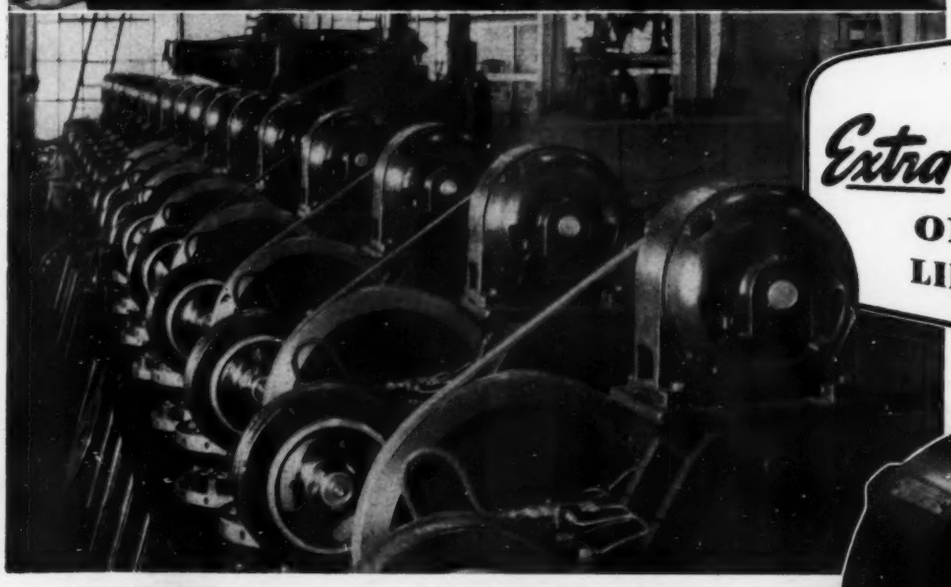
Pendant switch and conveniently placed levers that provide quick selection of feeds and speeds, of table adjustments and length of stroke give the operator complete control of the machine at his finger tips.

Machine illustrated is rated at 48" stroke. Other sizes can be built to meet requirements.

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED
MACHINE TOOL CORPORATION
ROCHESTER, NEW YORK

OFF THIS LINE
with
Extra Protection



for
Extra Production
ON LINES LIKE THIS!

TRI/CLAD MOTORS

REG. U.S. PAT. OFF.

POLYPHASE OPEN TYPE	SINGLE-PHASE CAPACITOR	POLYPHASE SPLASHPROOF
1-20 hp	1-5 hp	1-20 hp

We've hit our stride in the production of Tri-Clad motors—they're coming off our assembly lines in ever-increasing quantities. This fact pleases us doubly—as we think it will please you: In the first place, motors are vitally needed by hundreds of industrial concerns engaged in the defense program; and secondly, our near-peak production not only means more and more motors for American industry but better motors, too, because Tri-Clad motors embody *three* outstanding features which give additional protection for vital production:

1. **Extra Protection against Physical Damage**
2. **Extra Protection against Electrical Breakdown**
3. **Extra Protection against Operating Wear and Tear**

Specify Tri-Clad on your next order. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

750-44-8058

The Tools
You Buy Again!
DIVISIONS of the UNION TWIST DRILL COMPANY
UNION
BUTTERFIELD
S. W. CARD

Reamers by Butterfield

"Reamers by Butterfield" means the **right** tools for the job, correctly made for greater tool stamina, correctly designed and ground for precision results and constant high production speeds. Three words—"Reamers by Butterfield"—on your small tool specifications will be the key to the better results you need to meet today's production demands.

BUTTERFIELD DIVISION
DERBY LINE, VERMONT
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UNION
BUTTERFIELD
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DIVISIONS of the UNION TWIST DRILL COMPANY

for Service!

CARD

The CARD Quality

For over 66 years, the Card Emblem has been a reliable guide to efficient tools for producing accurate threads. Through the years, new types of threads, higher degrees of accuracy, tougher, harder materials, have always been met by corresponding improvements in Card Tap design. Try Card Taps and let the Service Test prove the wisdom of using the Card Emblem as your guide.

S. W. CARD MFG. CO.
MANSFIELD, MASS., U. S. A.

DIVISIONS of the UNION TWIST DRILL COMPANY

UNION
BUTTERFIELD
S. W. CARD

THE BLANCHARD TAKES IT

as it comes!

BLANCHARD

The Blanchard takes it as it comes — thin — thick — large — small — soft or hardened work — and gets it out.

Note the variety of work handled on the two machines shown here. This manufacturer has bought six Blanchards during the past five years.

It will pay *you* to put your flat surface grinding problems up to Blanchard — there is no obligation. Just write.

THE BLANCHARD MACHINE CO.
64 STATE ST., CAMBRIDGE, MASS.

WHAT ARE YOUR REQUIREMENTS?

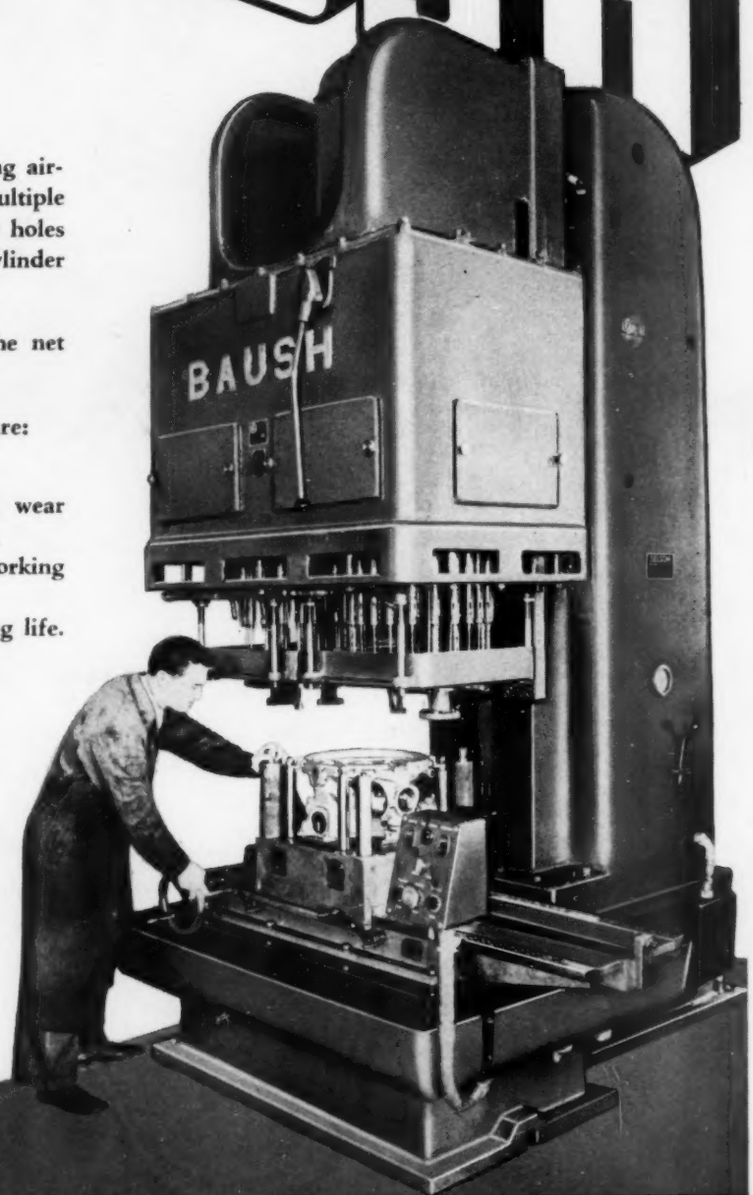
Mirror finish? Grey finish? Finish within 3 or 4 micro-inches? Absolute straightness and roundness? High production? Take a tip from the aircraft engine manufacturers—here, where finish, accuracy, and production are of such vital importance, Bryant Internal Grinders are the recognized choice. Overhead wheel slide, massive construction, rigidity, and ease of operation are features that are writing a new cost and production story in the aircraft industry. Let Bryant estimate the cost and production story on your own work—there is no obligation.

BRYANT CHUCKING GRINDER CO.
Springfield, Vermont, U. S. A.

SERIES 24 BRYANT
INTERNAL GRINDER

MULTIPLE DRILLING?

...IT PAYS TO CONSULT BAUSH



One of the many Baush Machines used in building aircraft engines is this Baush W-8 Hydraulic Multiple Spindle Drilling Machine, set up for drilling 50 holes in the front end of the wheel case for a 12-cylinder "V" type liquid cooled aircraft engine.

Using a two-station manually indexed fixture, the net production is 20 parts per hour.

Some of the principal features of this machine are:

- Mass and weight insure rigidity.
- Extra wide ways incorporating bronze taper wear strips contribute toward sustained accuracy.
- Streamlined column and head enclose all working parts.
- Selected alloy steel spindles and gears give long life.
- 2 regular spindle speeds, others thru pick-off gears.
- Positive vaporized oiling of spindles and joints.
- Electric controls inside the main column protected but accessible.
- A fixed cluster plate accurately bored for the layout.
- Baush designed fixture for maximum efficiency in handling.

There are three sizes in this series of machines, with capacities from 5 to 30 H.P. Write for complete data and specifications.

BAUSH MACHINE TOOL COMPANY, Springfield, Mass., - Detroit, Mich.

This 4 Spindle FOSDICK Drill...

maintains close accuracy and high production on **Defense Work**

Built in two sizes 4 BM up to 7/8" and 5 BM up to 1¼". Full descriptive Bulletin H.S.A. will be sent upon reequest.

•

Here a four spindle high speed Fosdick Drill is drilling aluminum bronze gear cases for anti-aircraft gun carriages at Bartlett Hayward Division of Koppers Company.

The operations are as follows:

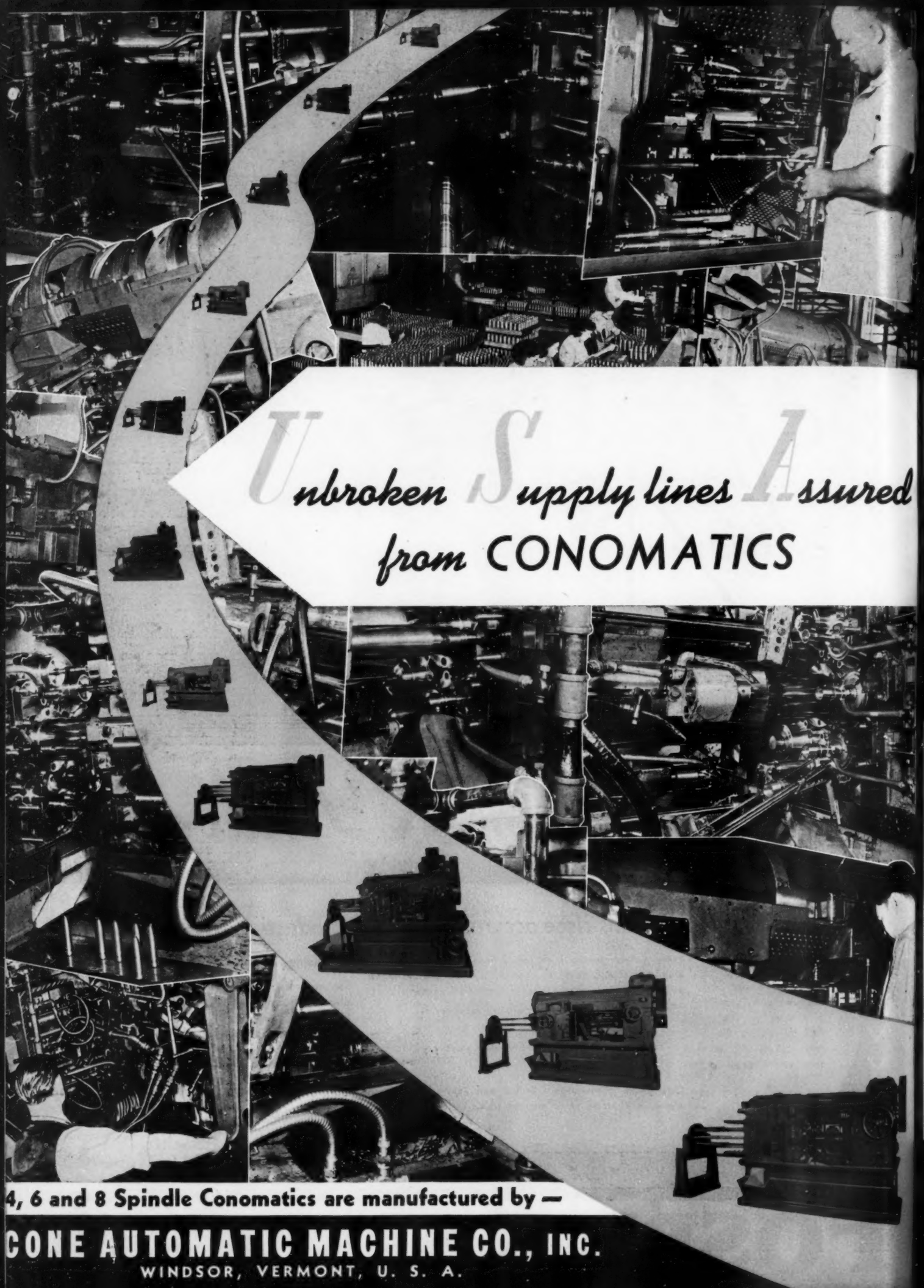
4—25/64" holes drilled
2—15/64" holes drilled
1—11/32" hole drilled through both sides
1—.3542 hole reamed to plus or minus .0003 through both sides

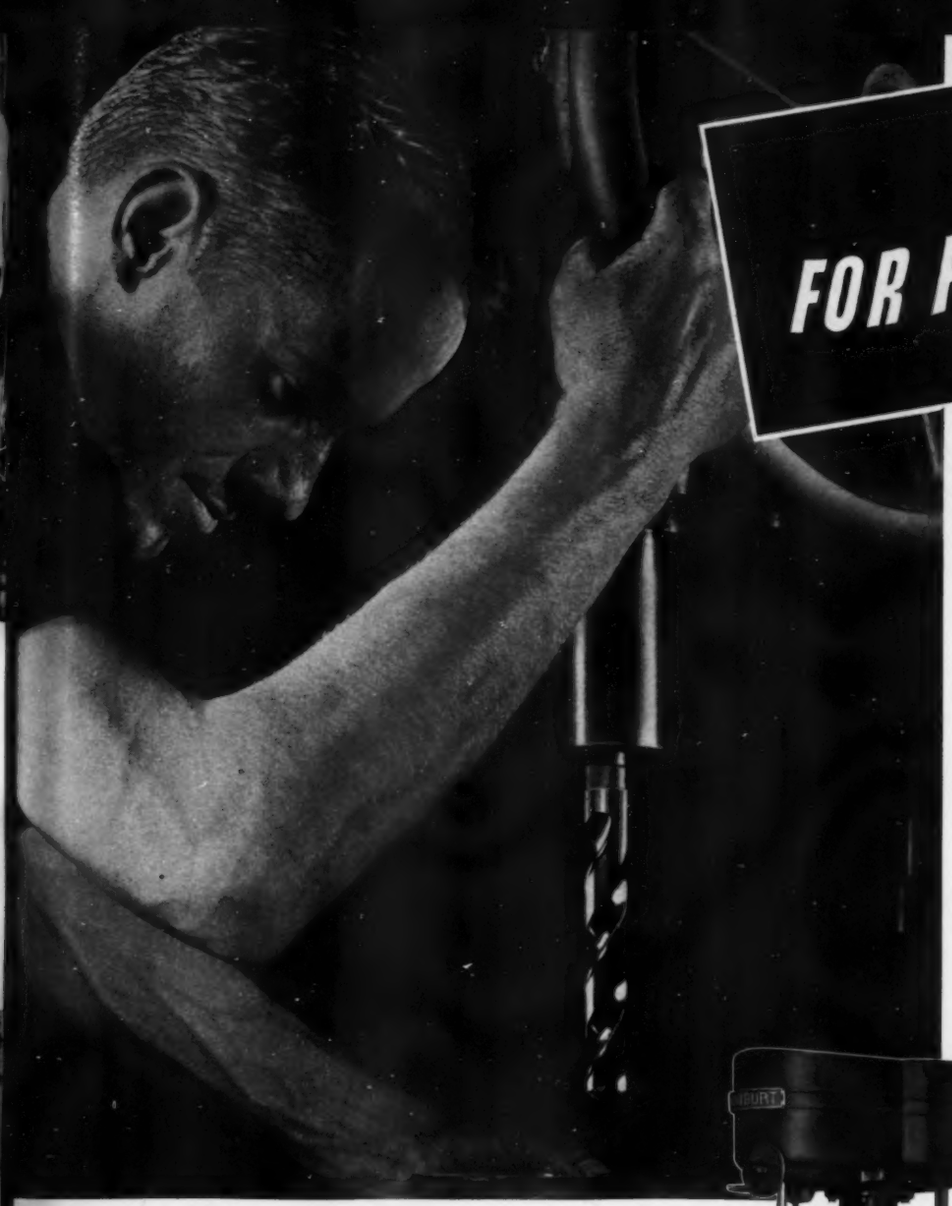
One piece is completely drilled and reamed as stated above in a period of six minutes which includes 1 minute for loading and unloading fixture.

The convenience of a wide range of feeds and speeds plus ample power and exceptional rigidity enables Bartlett Hayward to maintain both production schedules and tolerance limits on this job.

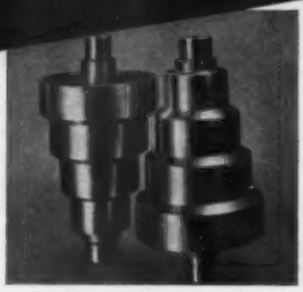
Your work may be different but if it requires drilling up to 1½" diameter or reaming to close limits you should investigate Fosdick High Speed, Sensitive, Ball Bearing Drills.

FOSDICK MACHINE TOOL COMPANY
CINCINNATI ··· OHIO


Unbroken Supply lines Assured
from CONOMATICS
4, 6 and 8 Spindle Conomatics are manufactured by —
CONE AUTOMATIC MACHINE CO., INC.
WINDSOR, VERMONT, U. S. A.

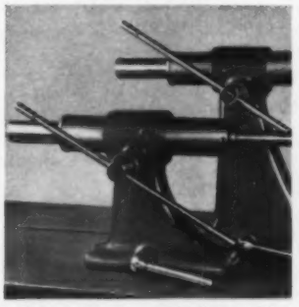


FOR FASTER DRILLING



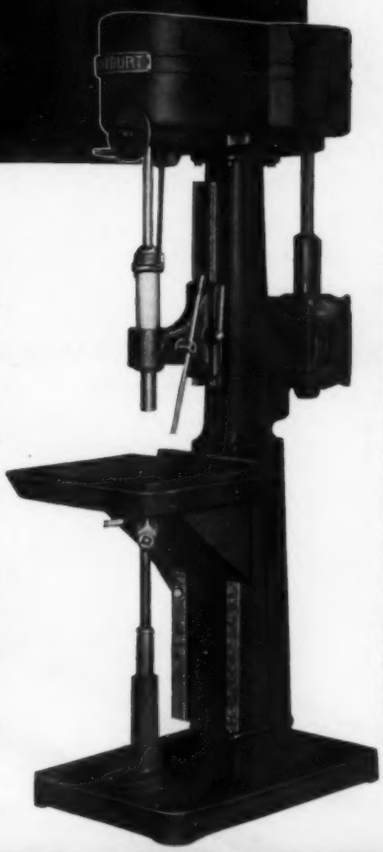
Solid cone pulleys keep drills from stalling.

New upper guard keeps mechanism covered.



Full ball bearing spindles—either 8" or 12" overhang.

Vertical motor drive uses standard motor for all speeds.



Footburt Sensitive Drilling Machines help you meet those new production schedules made necessary by the present emergency. They are full range machines and are built in sizes to meet most small drilling requirements.

Our present capacity makes it possible to quote early deliveries. Write or wire for full information.

THE FOOTE-BURT COMPANY
CLEVELAND, OHIO
Detroit Office: 4-151 General Motors Building

FOOTBURT *Sensitive* DRILLING MACHINES

THREE OF THE 26 MODEL 'B' CLEVELAND AUTOMATICS ON THE WAY TO PACKARD TO MAKE *Rolls Royce* AIRCRAFT ENGINE STUDS

• For certain kinds of work where simplicity of metal removal problems is more than matched by requirements for high speed of production, Model B Cleveland Automatics are supremely efficient. As here for instance where engine studs for Rolls Royce aircraft engines are needed in great quantities in a hurry, Model B will produce them at minimum cost and in shortest time.

Cutting tools can be mounted singly or in series for turning one or more diameters of various lengths. Double cross-slides carry forming and cutting off tools. Model B is built in short and long lengths to accommodate requirements, up to 18-inch stock feed, and can be equipped with rotary tilting magazine or hopper magazine for secondary operations. It will take work up to a 2½-inch diameter bar.

Model B Cleveland Automatics are used throughout America making such parts as tap blanks, shafts with multiple diameters, nipples, studs of various types and many other similar kinds of work. If your plant has a high speed production problem which suggests application of Model B, ask for bulletin describing its specifications in detail, and a representative will call upon your request.

THE CLEVELAND AUTOMATIC MACHINE COMPANY
2269 ASHLAND ROAD • CLEVELAND, OHIO

Sales Offices: NEWARK—15 Washington Street • DETROIT—2842 Grand Boulevard
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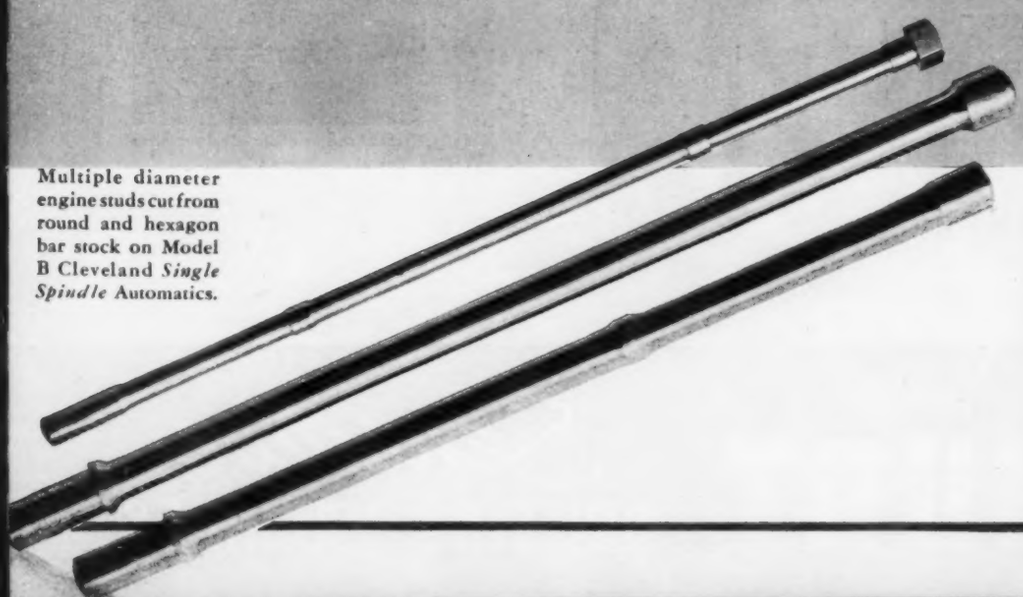


Multiple diameter engine studs cut from round and hexagon bar stock on Model B Cleveland *Single Spindle* Automatics.

PACKARD MOTOR CARS

Photographed through the courtesy of PACKARD MOTOR CAR COMPANY, Detroit, Michigan

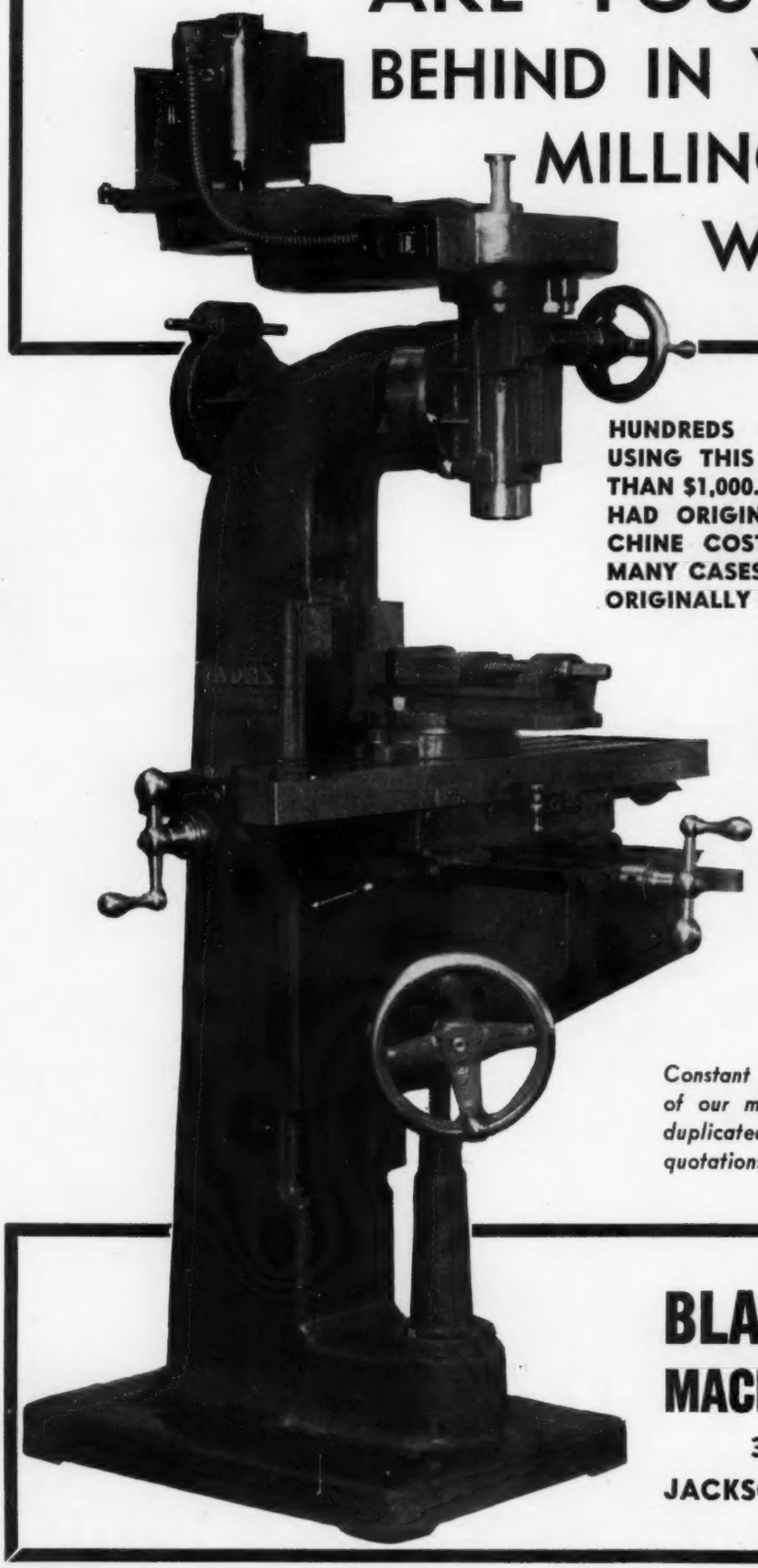
CLEVELAND

MODEL B *Single Spindle* AUTOMATIC

MODEL A—Built in 9/16-inch to 8-inch capacities inclusive

MODEL AA—Built in 1 1/16-inch and 1 3/8-inch capacities only

ARE YOU GETTING BEHIND IN YOUR MILLING MACHINE WORK?



HUNDREDS OF SHOPS ARE SUCCESSFULLY USING THIS MACHINE WHICH COSTS LESS THAN $1,000.00 TO DO WORK ON WHICH THEY HAD ORIGINALLY PLANNED TO USE A MACHINE COSTING $3,000.00 TO $7,000.00. IN MANY CASES PRODUCTION IS GREATER THAN ORIGINALLY ESTIMATED.

INVESTIGATE NOW!

IT MILLS slots, keyways, cavities and irregular curves with end mills 1/8" to 5/8" diameter in tool steel.

IT DRILLS to accurate locations without layout.

IT BORES up to 3" holes in steel—vertical, horizontal or at angles.

HAS VERNIERS for locating 8" x 16" at one setting.

●

Constant repeat orders testify to the performance of our machines . . . Performance that can be duplicated in your plant. Write to us for details and quotations!

BLANK & BUXTON MACHINERY COMPANY

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JACKSON MICHIGAN

LARGE VOLUMES

. . . for Coolant or Transfer Work

Nos. 225 and 245

MOTOR DRIVEN CENTRIFUGAL PUMPS

- Compact
- Wide flexibility of installation
- Totally-enclosed motors
- Long-lived design

Use dependable Brown & Sharpe Pumps

. . . . for coolant — pressure — lubrication — hydraulic operation of machines — and miscellaneous combinations.

Tell us your pump needs —

B·S

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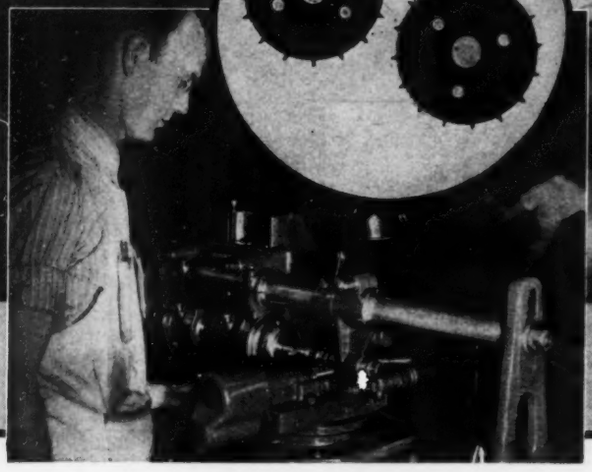
BROWN & SHARPE

Film Sprockets Finish Hobbed In One Operation with B-C Hobs



Sprocket Tooth Form, Spacing, and Runout Held to Precision Accuracy

Quick Facts

Hob — Special B-C ground topping sprocket hob 1⅞″ dia. and length, ¾″ str. bore, 13 gashes, single thread.

Part — Film sprocket for moving picture projector.

Material — Stainless steel.

Operation — Hobbing special sprocket wheels having 16 teeth, 1.581″ ±0.001″ O.D., 0.046″ face, 0.036″ ±0.001″ tooth thickness, 1.455″ root dia., 0.295″ circular pitch.

Hobbing Machine — B-C No. 3 Precision.

Holding — Chuck collet arbor.

Feed — 0.007″ per rev. of work.

Hob Speed — 157 r.p.m.

Production — Approximately 16 minutes per load of 15.

Accuracy — Tooth form must be very accurate. Total runout within 0.001″ on O.D. Tooth thickness 0.036″ ±0.001″.

Pieces per Setting — 200.

Pieces per Grind — 800.

Remarks — This special hob designed by B-C Hob Engineers, and used on a B-C No. 3 Precision Hobbing Machine, solved a particularly difficult production problem presented by the form of the part and nature of material.

Gearing for this purpose requires the utmost in accuracy, otherwise the delicate film passing over the sprockets, at the relatively high speeds employed, would be damaged.

Barber-Colman Hobbing Service solved this problem by designing a special ground hob which is used on a Barber-Colman No. 3 Precision hobbing machine. A load of 15 stainless steel sprockets is hobbed at one time, holding tooth thickness to 0.036″ ±0.001″, and runout on the outside diameter within 0.001″. Production is approximately 16 minutes per load of 15, and the hob life is 800 pieces per sharpening.

This is another example of a tough manufacturing problem that was solved by Barber-Colman Hobbing Service. If you have a similar part or some other part that could be produced by the hobbing process, rather than by another method, it may pay you to put it up to the B-C Engineers. There is no obligation.

● Right: Here is the special ground sprocket hob that is used to produce film sprockets to precision accuracy on a production basis. Many times it is possible to use the hobbing process to manufacture parts with greater accuracy and at lower cost. See pages 60 to 64 in Catalog K for special hobs and miscellaneous special hobbed forms.

BARBER B-C COLMAN PRODUCTS

HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

Barber-Colman Company

General Offices and Plant 201 Loomis St., Rockford, Illinois, U. S. A.

The SUPER SERVICE Radial

ON DUTY NOW!

Especially on big cumbersome work in the defense industries where centralized control at drilling positions makes important time savings.

For further information of the Super Service Radial on Upright Metal drilling machines, write us.

Learn how these machines are different from other drills of today, making it possible for you to save energy, time and money, with this 100% centralized control at the head.

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.

A WARNER and SWASEY 2-A UNIVERSAL HEAVY DUTY TURRET LATHE equipped with a cross sliding hexagon turret, turning a crankshaft for an aircraft engine.

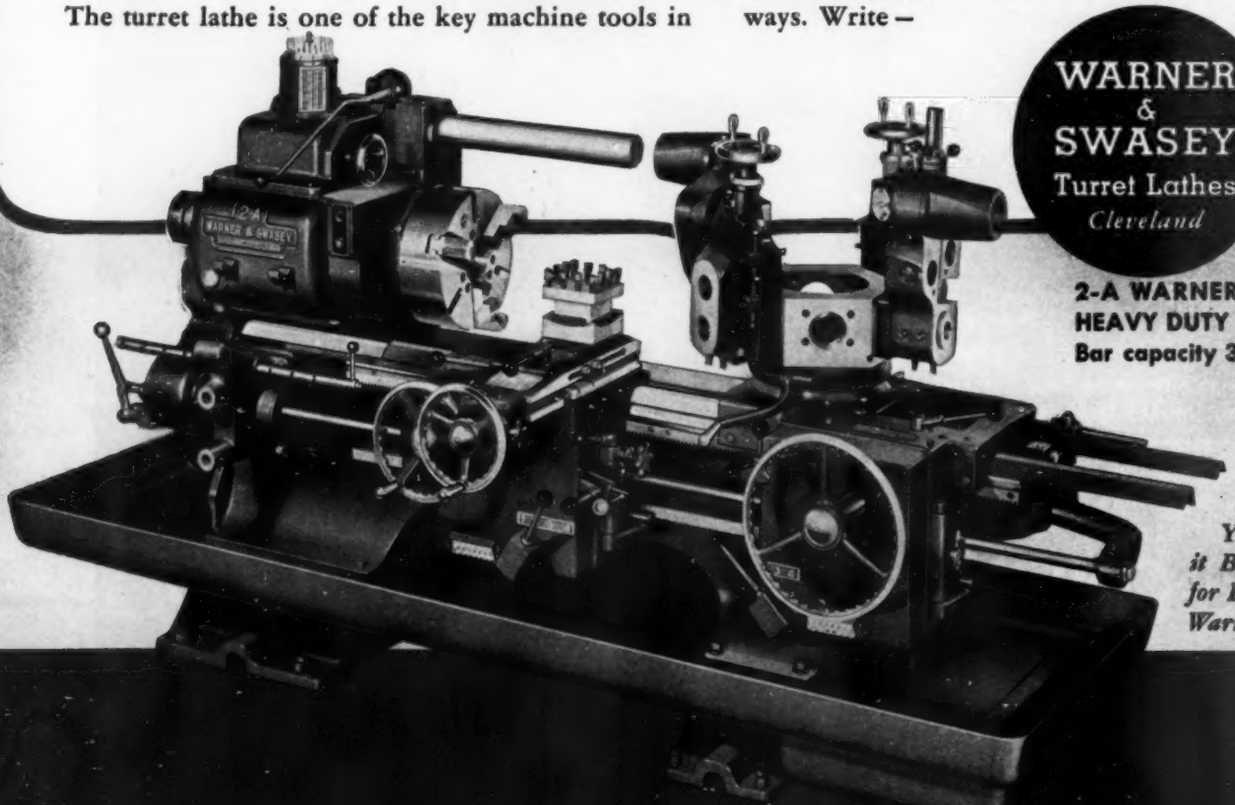
Private Industry MUST ARM AMERICA

● Fully 95% of the guns, planes, tanks, trucks, ammunition and countless other sinews of war and defense must be made in privately owned shops. These plants, large and small, are diverted in whole or part from their normal production of peacetime articles.

Strange new blueprints come to the hands of machine tool operators. Executives are confronted with production schedules that tax the capacity of both old machines and the new machines which are being installed.

The turret lathe is one of the key machine tools in this picture. Warner and Swasey knows that working night and day, with an enlarged plant, to produce new turret lathes, is not a complete answer. Old turret lathes must be made to produce more. New turret lathes must be used to full capacity.

That is why we urge you to (1st) see what we can do to revitalize old turret lathes; (2nd) learn what modern Warner and Swasey small tools can do for you; (3rd) let us help you train your operators to be better workmen. We can help turret lathe operators in many practical ways. Write –



WARNER & SWASEY
Turret Lathes
Cleveland

2-A WARNER and SWASEY HEAVY DUTY TURRET LATHE. Bar capacity 3½"; swing 20".

You Can Turn it Better, Faster, for Less . . With a Warner & Swasey

WHAT'S IN THIS ISSUE

P. W. BROWN

AIRCRAFT ENGINES

One new radial air-cooled aircraft engine every 24 minutes! That's the remarkable assembly rate at the Wright Aeronautical Corporation's plant in Paterson, N. J. To accomplish this feat, floor space has been expanded three and one-half times; manpower increased a little more than three times. But over the same period output has been expanded more than six times! This was accomplished by adopting the "in line" principle of mass production and by the installation of specially designed multiple-tooled machinery. In the Armament Section, beginning on page 595, P. W. Brown, Wright's assistant works manager, recounts the story for you in "Wright Turns to Line Production."

SPUN HEADS

Since the United States began its defense program, time has become an all important factor. Any device which saves time is worth more than money can buy. J. J. Molette and J. C. Bohan, manufacturing engineers, South Philadelphia Works, Westinghouse Electric & Mfg. Co., have cut the time for rivet heading by 65 per cent. They tell how it's done in "Spun Heads Save Time" beginning on page 591 .

SPRAYED COATINGS

Successful application of sprayed coatings depends on a proper handling technique and maintenance of equipment. Although many troubles are encountered in paint spraying, most of their causes and remedies have been tabulated in the reference book sheet beginning on page 619. You will want this valuable material for reference.

MOLDS FOR PLASTICS

More and more articles are being made from Plastics these days and more and more attention is being paid to the factors which have a bearing on production problems. George P. Lehmann, plastics department, General Electric Company, considers every angle, every conditioning factor, in "Proper Molds for Plastics" which begins on page 584.

STOCKROOM INVENTORY

Keeping track of more than 6,000 different parts and raw materials and having them ready for assembly when needed is a tough job for any stockroom, large or small. But the George Gorton Machine Company, employing only 200 men, has done just that. The company has worked out an efficient inventory system with the result that it has been able to turn out a large dollar volume each month. A complete description of the Gorton "Small Shop Stock Control" begins on page 588.

FLAME HARDENING

During the past decade, flame hardening of large gear teeth became a standard operation. Subsequent development of the process—it's still going on—has found many new applications. At present, flame hardening is often used where furnace methods are difficult or impossible. J. D. Magrath, applied engineering department, Air Reduction Company, has gathered the most complete data on "Oxyacetylene Flame Hardening." In a series of articles he runs the gamut from earliest history to the newest wrinkles. Part I, beginning on page 581, presents "History and Advantages." You won't want to miss this valuable data.

J. G. MAGRATH

GEORGE P. LEHMANN

WANTED: PRACTICAL IDEAS

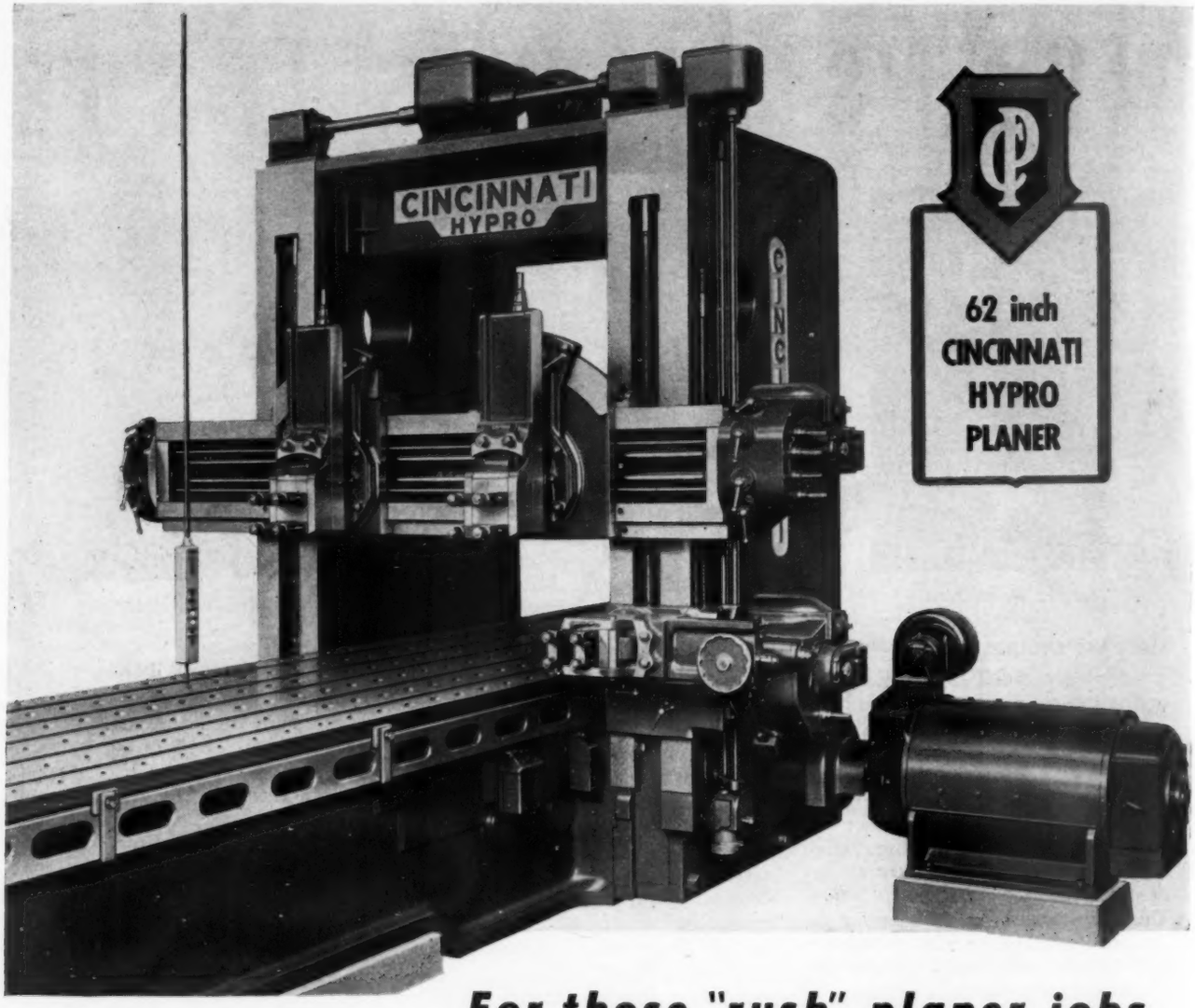
Most people who give free advice are constantly up in the clouds of pure theory. Consequently many of their ideas never work in practice. AMERICAN MACHINIST, while it uses theoretical data when the occasion demands, always seeks "Ideas From Practical Men." Some of the latest contributions are:

Martin H. Ball tells about "Long Roll Stiffened with Truss Rods." You can learn how to do it by turning to page 592.

If you want to know about "Duplicating Threads with a Spring Caliper," H. B. Martin recounts some interesting results and methods on page 593.

COMING

"Welding of Magnesium," an interesting yarn by H. O. Hoglund, Aluminum Company of America, has been scheduled for the July 9 issue. Future Armament Sections, which, by the way, have become extremely popular features, will include a description of "How General Electric Builds Pack Howitzers" based on current defense operations at this country's Erie works. Subcontracting on which the success of many government orders now rests is also a big factor. Horace Wall, of G.E., will tell how his concern handles this phase of its activities. He stresses the importance of anticipating future requirements. You won't want to miss hearing how this is being done. In the next issue, W. B. Brooks, Carnegie-Illinois Steel Corporation, will describe the "Machining of Stainless Steel."



JUST SEND ONE DOLLAR

and ask for "Treatise on Planers". You will receive this helpful book containing complete data on planer operation.

For those "rush" planer jobs
CINCINNATI HYPRO

Improved high speed steel accounts for the increased rigidity built into Cincinnati Planers and for the extra support given to cutting tools to eliminate chatter under heavy cuts at greater speeds and feeds.

Forged steel herringbone rack . . . all steel complete herringbone gear train . . . anti-friction bearings on all screws and rods . . . full bearing slide and inverted dovetail . . . extended saddle for harp support . . . reinforced tool block abutment represent a partial list of high production features productive of greater power and sustained accuracy over years of heavy production.

These are also points of inherent design which help Cincinnati Planers meet the rigid requirements of defense work and will keep them "fit" for post war service.

If it's a Planer job it's a Cincinnati job. Want details? Ask for bulletin No. 62. Sizes from 36" to 120".

THE CINCINNATI PLANER COMPANY
CINCINNATI···OHIO···U. S. A.

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

OXYACETYLENE FLAME HARDENING—1

History and Advantages

COMPILED BY J. G. MAGRATH, APPLIED ENGINEERING DEPARTMENT, AIR REDUCTION COMPANY

Beginning with rail and gear applications, flame hardening has found many uses, often for work difficult or impossible to handle by furnace methods

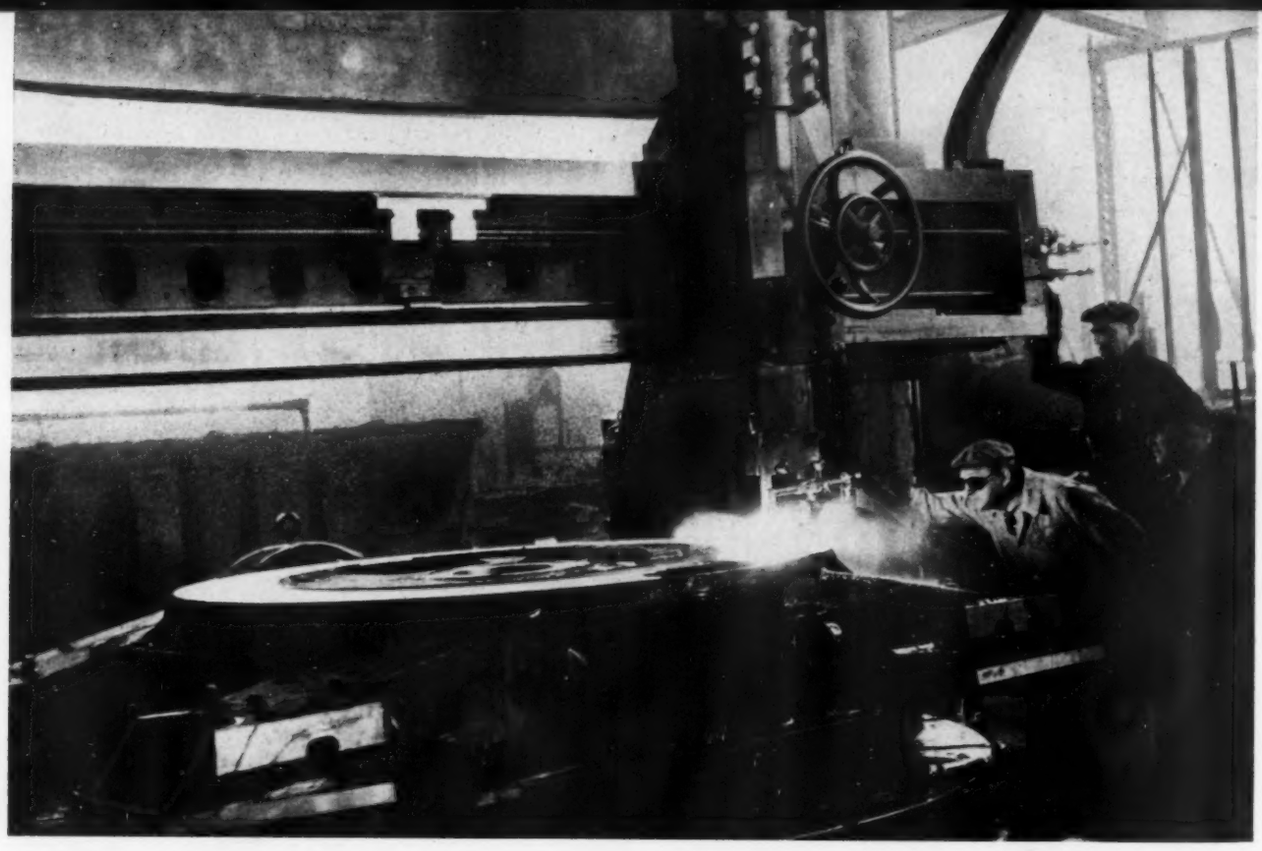
FLAME HARDENING needs no introduction to the metallurgist, the engineer or the heat-treater. The ability to surface-harden steel by the means of flame and quench dates from the inception of oxyacetylene welding. Selective hardening, using a torch, was practiced for nearly 30 years by toolmakers for hardening the edges of sheet-steel contour gages. Over 23 years ago in England, Sumpter flame-hardened gear teeth. Ten years later Shorter developed mechanical uniformity in the process. Studies and research abroad and in America have since contributed much to the general knowledge of the subject.

The introduction of rail-end flame hardening in 1937 to reduce rail joint maintenance, and the subsequent widespread adoption of this process as a routine maintenance operation by many American railroads, marked the first large-scale application and focused attention on the development of apparatus suitable for industrial use. In the early stages, the development of the process was hindered by the lack of suitable water-cooled apparatus capable of maintaining broad areas of staple oxyacetylene flame in close contact with the heated metal.[1]

During the past decade, flame hardening of the teeth of large gears has become a standard operation, and an active development of the process to include a wide variety of mechanical parts is now in progress.

Advantages of the oxyacetylene flame hardening process are numerous. Machine elements, mechanical and structural parts, heretofore impossible or impracticable to be otherwise surface hardened, may be hardened quickly and economically. Large parts, particularly

First widespread use *of flame hardening in America was the heat-treating of rail ends. This process is applied by the unit area method. The rail head surface to be hardened was gradually raised above the critical temperature, employing an oxyacetylene heating torch with large single orifice tip, by a reciprocating movement of the flame. Then the entire area was quenched with water and the torch again employed to raise the surface temperature to provide the proper degree of draw. Today, after nearly fifteen years of employment, the application is commonly accepted and automatic flame hardening track machines have been developed*



Large parts *as well as small come within the scope of the flame hardening process. This six-ton crane car body casting is mounted on the table of a vertical boring mill to harden the roller track. As the table revolves a torch held in the side head is fed across the casting to harden a path of the required width*

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4. NOTES ON FLAME HARDENING, by G. V. Slottman, July, 1940.

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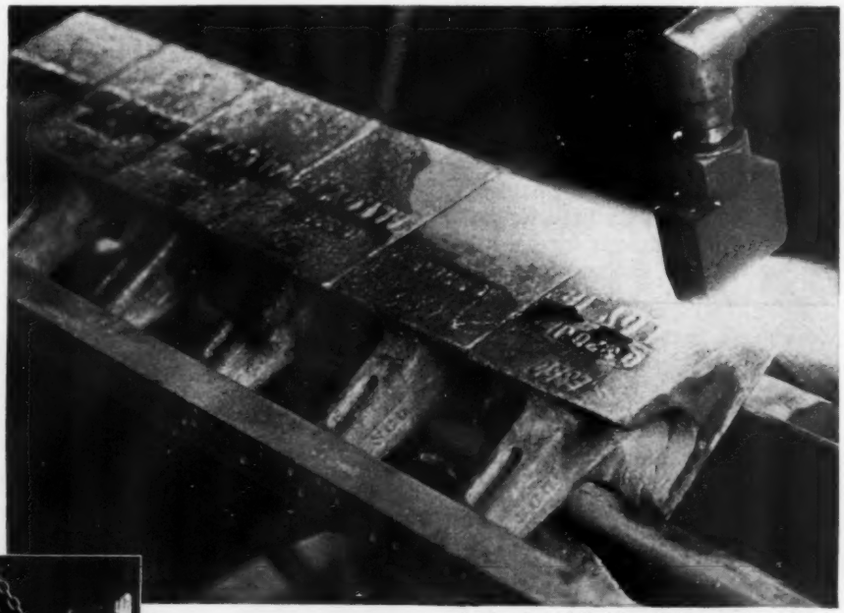
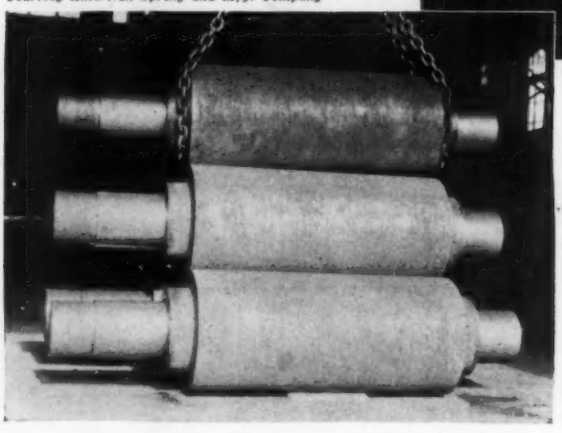


Courtesy Central Machine and Flame Hardening Works

Courtesy American Spring and Mfg. Company



Flat or circular surfaces *are flame hardened with equal dexterity. In the case of flat surfaces, such as the shovel teeth shown above, the work may be laid horizontal and the flames traversed across it at the proper speed to heat to the required depth—with quench medium in adequate volume and pressure, to provide the desired hardness. This is known as the progressive method. Circular shapes, such as the necks of the table rolls shown, which are flame hardened to eliminate the necessity of an inner race for the anti-friction bearing, are mounted on a turning spindle. The work is revolved past the flames at a slow speed in the progressive method, or revolved at a high speed while a circumferential band of flames travels along its axis in the spinning method*

of a size that prohibits furnace hardening, may be quickly surface-treated on contact areas to a predetermined hardness and depth.[2,3] Flexible and applicable to a variety of shapes, this process finds wide usage in many industries.

The outstanding feature of the process is its ability to limit the hardness to shallow surface areas without affecting the desirable properties in the underlying core metal. In furnace hardening, because of the slow rate of heating, it is difficult to achieve a high surface hardness and core ductility. The major field for flame hardening will be found where it is advantageous to provide small hardened areas on parts of large size, and particularly when it is necessary to have high degrees of hardness.[4] Flame hardening also finds application in many places where occasional use might be made of furnace hardening, but where the volume of work is insufficient to warrant the construction of a hardening furnace. Further, when small objects are not produced in quantities to warrant furnace hardening, the flame process serves economically.

Flame hardening combines the simplicity of hardening by heating and quenching with the features of case carburizing; it leaves a tough, ductile core resilient and resistant to shock. Hardness may be localized where needed. The degree of hardness obtainable is equal to, and in many cases, greater than that possible on steel of the same analysis after furnace heating followed by quenching.[5, 6] The maximum hardness is generally maintained over two thirds of the hardened area. The depth of hardness is predetermined and uniform, as the speed of heat input is under exact control. The speed of the process causes the parts to be pit-free and scale-free,[2] thus eliminating subsequent descaling costs and loss in dimension. Frequently finished surfaces may be flame hardened, effecting considerable savings in machining and regrinding costs. Use of expensive wearing strips and liners are often avoided[3] because of flame hardening internal surfaces of nearly any dimension.

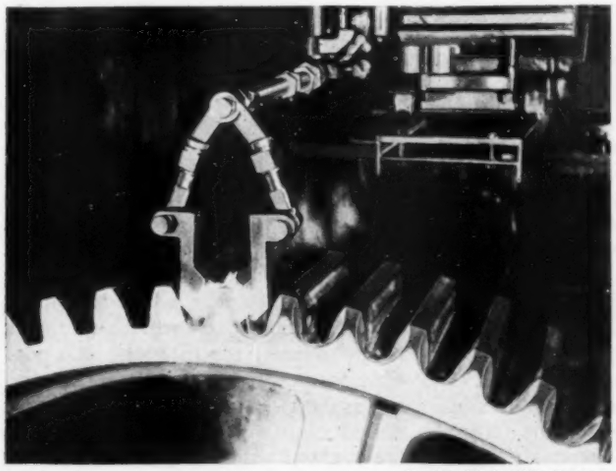
Flame hardening allows for the surface treatment of thin sections which would not be possible with furnace heating followed by quenching, as the slowness attendant to furnace hardening might result in excessive penetration. On heavy objects, in flame hardening, the unheated underlying metal will assist the external quenching medium and permit the use of a less drastic quench than would otherwise be required.[2] The rapid rate of heating furnished by the process and the sharp temperature gradient between the surface and the interior of the object, provide a substantial self-quenching effect which is sufficient to produce the desired surface hardness, on certain steels, by air cooling. The process permits freedom in selection and treating of delicate steels which are prone to check or crack in furnace hardening as only a thin layer of metal is raised above the critical temperature and cooling is both internal and external.

Flame hardening makes it possible to obtain full hardness on the surface of a casting or forging which has previously been heat-treated to give the maximum in physical properties for the strength of its core. Since the process treats only a small depth of the surface, internal strains are minimized. There is no sharp line of demarcation between the case and the core as the hardness falls off. Flaking and spalling under service are avoided.

Distortion is minimized as the heating and quenching are uniform, being under definite control. Since it is a localized treating process, less distortion results than where the whole mass is heated and quenched.[5] That distortion which may occur is generally well within manufacturing tolerances.

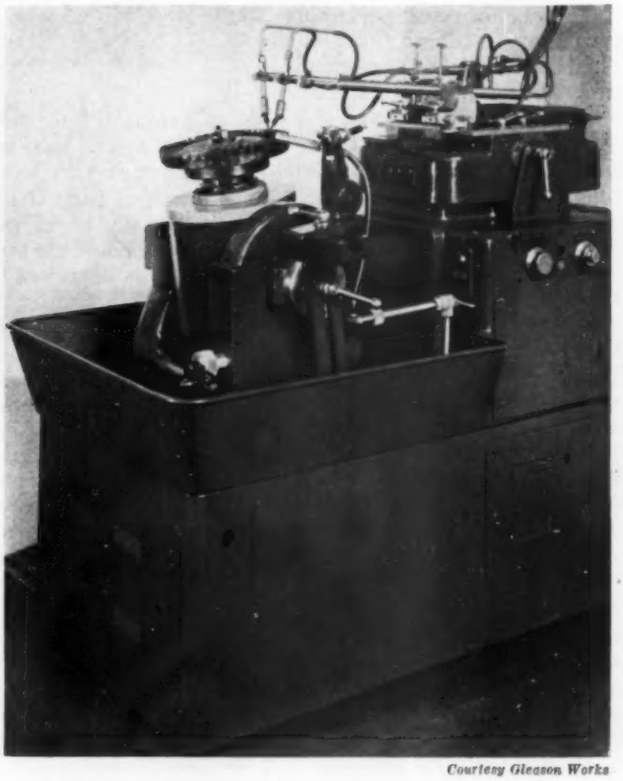
The standard apparatus available for the application of the process is simple in construction, light in weight and fully portable. Therefore the process is portable in the sense that heat may be carried to the work instead of the work being necessarily carried to the heat.[7] It will function in the shop or in the field and may be operated either manually or mechanically. Its portability permits large parts to be treated without removal from assembly.

Part 2 of Mr. Magrath's series on flame hardening will follow soon.



Courtesy W. S. Bidle Company

Flame hardening of gear teeth *is now standard practice. Hardening the tooth surfaces of a gear approximately doubles the wear load carrying capacity. All types of gears, straight bevel, spur, helical, and internal may be so processed. Simple mechanical set-ups using standard apparatus will allow for the handling of the ordinary run of miscellaneous sizes. Where medium and large production under accurate control is a requirement, then gear flame hardening machines, such as the Gleason Works machine illustrated, should be employed*



Courtesy Gleason Works

Proper Molds for Plastics

BY GEORGE P. LEHMANN, PLASTICS DEPARTMENT, GENERAL ELECTRIC COMPANY

Rules used for handling other materials must be forgotten when plastics are adopted. One consideration is the design of molds that will work properly

Hobbed cavities are produced by forcing a hard steel master into a softer steel blank. This method of producing cavities is especially useful when a number of identical molds must be made

SUCCESS OR FAILURE of a plastic product may depend on design and construction of the mold. If the pressing or molding is not carried out properly, all of the work leading up to this stage will have been wasted. Even so, the primary consideration for anyone who sets out to design a new article in plastics is to turn out something that *can* be molded at a reasonable cost.

First of all, it must be remembered that plastic materials are as distinct in their characteristics as are metals, glass, wood and stone, and must be treated with the proper consideration in order to derive the maximum benefits. For instance, it is not good practice to design a new part to perform a certain function and then decide on plastics as the material of construction only as an afterthought. Instead, the plastics material should be kept in mind at all times during the designing process. It also should be remembered that plastic materials have characteristics as widely different as metals, so the special type of plastic must be known to be used successfully.

One of the determining factors in the design of a molded plastic part is the permissible wall thickness. The walls and other sections of a plastic part must be thick enough to provide the mechanical or electrical strength necessary to withstand the abuse of constant service. Reduction in wall thickness has the combined effect of reducing the weight, the material cost, and the curing time, but if carried to extremes produces a fragile brittle part which will not withstand the ordinary abuse of extraction from the mold, or of packing and shipping. Although walls as thin as $\frac{1}{16}$ in. are sometimes used, a generally accepted minimum wall thickness is $\frac{3}{32}$ in. for the average small size, general-purpose molded part. For larger pieces, such as radio cabinets, the minimum safe thickness increases to $\frac{1}{4}$ in. Extremely large parts have been molded in England with wall thicknesses of as much as $\frac{5}{8}$ to $\frac{3}{4}$ in. A domed top for molded parts is advisable for greatest strength, better moldability, and easy extraction from the mold.

It is important that wall sections be kept uniform in a given molded part, since variable section thicknesses produce uneven shrinkage and consequent stresses in the molded part after it has been extracted from the mold. In addition, the curing cycle for the molded part is lengthened unnecessarily since in parts with non-uniform sections, the curing time is determined by the thickest section. In extreme cases production must be slowed down noticeably, as the mold temperature must be lowered to prevent burning of the thin sections. Good and bad designs, involving walls joined at one end of a part are shown in Fig. 1. At *A* is shown a part with non-uniform sections which are apt to cause warping. An improved design is shown at *B* where uniform sections reduce the weight of the part and allow a shorter curing cycle.

Relatively close tolerances can be met in molded plastics parts, but the designer of a given part should bear in mind the fact that the mold will cost more when the tolerance is held to a closer limit. Further, where tolerances are close, more parts will be scrapped for not meeting specifications. It is possible to meet requirements of plus or minus 0.003 in. per in., for almost any dimension in a molded part. However, the slightest distortion of the mold in the hardening process must then be corrected by tedious hand-stoning of relatively inaccessible surfaces.

Designers should avoid the common pitfall of specifying tolerances which are more exact than are necessary for the proper functioning of the part. The tool engineer, who must design the mold and be responsible for its proper operation, likes to include a certain amount of draft or taper in the mold to assist in obtaining good density and

finish, and to permit easy extraction of the molded parts. The amount of draft may vary from one to three degrees, depending on the part, its shape and its application. Of course, parts can be molded without draft, but the output then is lowered and the piece price is increased.

Closely related to tolerances is the subject of mold shrinkage allowances for the various plastics compounds. When a part is molded of a thermosetting (heat-hardening) compound in a hot mold, a definite shrinkage takes place as the compound cures. This shrinkage varies in the various molding compounds. It must be compensated for when designing the mold. A straight resin molding material will require a large shrinkage allowance, a compound with an organic filler will require less allowance, and a compound with an inorganic (mineral) filler will require the least allowance.

The designer should keep in mind the fact that the mold is the reverse of the molded part. Hence, a hole or recess in the molded part is formed by a projection in the mold. These projections must be proportioned so that they will not be broken or bent by the heavy mold closing pressures of from 2,000 lb. per sq. in. upward. Depth of small holes in the part should not exceed twice their diameter. Correct hole construction is indicated at *A* in Fig. 2. A hole $\frac{1}{8}$ in. in diameter should not be more than $\frac{1}{8}$ in. deep. A hole too long for its diameter is shown at *B*.

Bosses Should Be Tapered

High bosses or barriers which must be formed by deep recesses in the upper mold member should be avoided because of the difficulty of machining the mold. Such elements often lead to trouble during molding from entrapped gas, with consequent decreased density and strength of the molded material at the crest of the projection. If high bosses or recesses must be formed, they should be designed with at least a five-degree taper and with generous radii at the top and bottom. It is difficult to make sharp corners in deep mold recesses, since the steel must be removed with hand tools. If possible, the designer should call for the radius formed by the milling cutter used to machine the recess.

In cases where the design normally would call for a large, otherwise unsupported surface, it is good practice to add supporting ribs. These ribs strengthen the molded part. In addition, they assist greatly in the flow of molding compound to remote portions of the mold, and help to prevent warpage of the part when it is pulled hot from the mold. Large, plain surfaces are susceptible to flow lines (undesirable ripples) and should be broken up into smaller areas by the use of a simple design, a stippled pattern, or some similar treatment.

The use of fillets on all molded parts is important. Fillets increase the strength of molds and molded parts alike, by avoiding sharp edges and cleavage lines. These rounded corners assist in the free flow of molding compound to all parts of the mold, and serve to prevent the compound from lodging in recesses where it may cure prematurely and result in a poor fusion or *knit* with compound which cures later. Fillets with generous radii provide mold surfaces which are easily finished or polished.

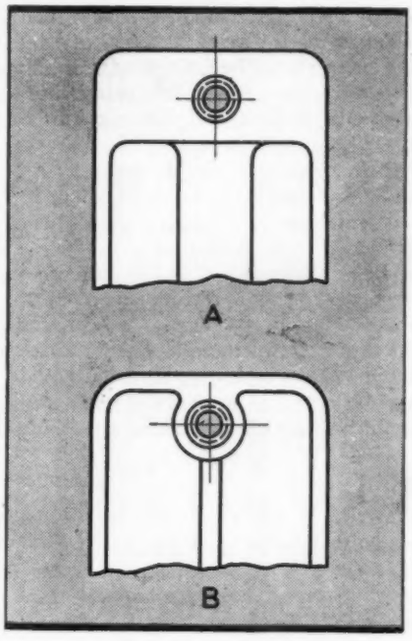


Fig. 1—Non-uniform sections, as at A, *require a longer cure and are apt to cause warping. Where sections are uniform, as at* B, *the weight of the part is reduced and a shorter curing cycle may be used*

Fillets should not be used at the mold parting line or flash line if they can be avoided. The edges or corners of the molded parts at such positions should be square, in order to give a very thin and easily removed fin of molding compound. Adherence to this rule will reduce the labor involved in cleaning and finishing the part. At *A* in Fig. 3 is shown a section of a part with a flash line which is hard to clean, while at *B* is shown the same section redesigned to provide a flash line which can be removed easily without damaging joining surfaces.

The use of inserts complicates both mold construction and the molding process, but provide compensating advantages in the part. The material used for inserts may be almost any of the common materials of construction, such as metal, glass, fiber, paper, or even other molded plastics parts. Metal inserts are the most common. One of the advantages accruing from the use of inserts is that the insert provides a simple means of fastening other parts securely to the molded plastic.

If inserts are used, proper design precautions must be taken. Do not use long, slender inserts unless they can be supported in more than one place in the mold. Poorly supported inserts may be bent, if not sheared off, by the flow of compound as the mold closes. Place inserts in a vertical position so that they will not interfere with the normal opening and closing of the mold. If it is necessary to mold inserts horizontally, these inserts should be as short as possible.

Do not mold inserts with very thin walls of compound around them, since there will be insufficient anchorage, the compound will be restricted in its flow, and the shrinkage of the compound

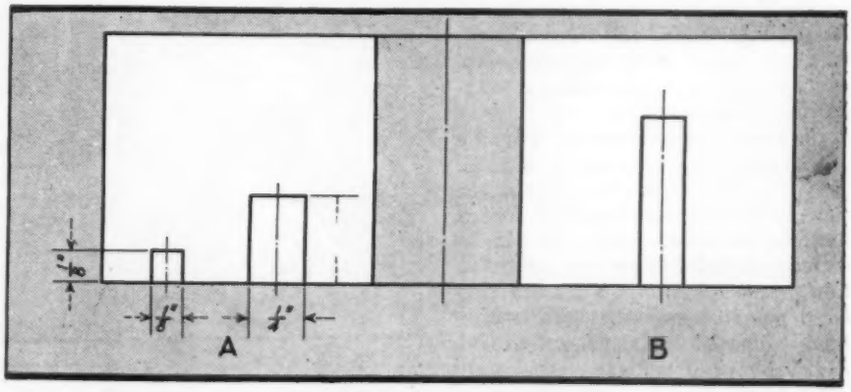


Fig. 2—Holes or recesses in a molded part are formed by projections in the mold. Correct and incorrect hole designs are shown. The holes at A *are proportioned for economical molding without danger of shearing off the mold projections, while the hole at* B *is too long for its diameter*

may cause it to crack. Large metal inserts may cause cracking in a molded part because of the difference in expansion of the metal and the plastic material. Shrinkage of the plastic around such an insert may cause cracking or breakage of the part upon extraction from the mold, or even later.

Good anchorage of inserts in the molded part is most important. This anchorage is obtained in several ways. Round stock can be grooved or knurled easily in a screw machine. Square, hexagonal or other stock can be grooved or drilled to provide anchorage. Good and bad anchorage of inserts is indicated in Figs. 4, 5 and 6.

Round Inserts Are Best

Where threaded inserts are used, it is wise to take precautions to prevent the compound from fouling the thread. A shoulder on the insert, as shown in Fig. 5, which will butt against a mold surface assists in holding the compound away from the hole around the insert. Inserts which must enter the mold for positioning should be circular in cross-section or, if other than circular, should have at least the portion which enters the mold turned to a circular cross-section. The reason for this is obvious when one considers the difficulty of making round and square or other odd shaped holes in the chrome nickel steel used for making molds. At *A* in Fig. 4 is shown the incorrect use of an hexagonal insert.

If an insert enters the mold with a fit tight enough to assure that the compound will not leak, a knockout pin should be provided in the mold to push directly on the insert, thus avoiding stripping parts from their inserts on ejection from the mold. Threaded inserts with through holes, as at *B* in Fig. 6, always require retapping in order to remove the compound which enters the hole during the molding operations. Such cleaning operations add to the cost of molded parts, but often are justified. Capped or relieved-bottom inserts, Fig. 5, give full thread length with a relatively short over-all length, and also prevent compound from entering the threads.

Care must be used when designing inserts which will function as electrical contacts. The sparks occurring at the time of making and breaking contact must be kept away from the plastics material in order to prevent carbonization or deterioration. Where an electrical potential exists between two inserts, sufficient creepage and arcing distance must be maintained, by means of a barrier if necessary, to prevent breakdowns.

Molded letters, Fig. 7, are useful and relatively inexpensive means of ornamentation on molded plastics parts. In general, it is better and less expensive to use raised letters because they can be stamped or carved in the mold. Letters, numbers or designs are produced in bas-relief by carving them in intaglio in the mold. Engraving and pantograph machines are used for reproducing a freehand or master (positive or negative) design in the steel. If depressed letters are desired in the molded part, it is necessary to provide raised letters in the mold. This is expensive unless the mold cavity is produced by hobbing, in which case the opposite of what has been said above is true. Hobbing is the process of producing mold cavities by forcing a hardened steel master into a softer steel blank. A great many identical cavities can be produced by a single master hob in a very short time. Whereas it usually is a tedious and difficult job to machine a complicated mold cavity, a hob to produce a similar cavity might be made easily, and would then be available for producing a number of duplicate cavities.

Raised letters, fluting, or other designs need not protrude more than 0.008 in. from the surrounding surface to produce the desired effect. Small letters ($\frac{1}{8}$ in. or less in height) should not be raised as high. The danger in getting letters too high is the possibility of having cleavage lines develop at their base. In case raised letters might interfere with the assembly of a device, or be objectionable for some other reason, the lettering can be stamped on a raised pad in the mold, and then appear as at *B* on the molded part.

Demand for wiped-in color in molded designs or letters is increasing. The secret of obtaining crisp, clean, filled letters is to provide sharp-edged, narrow, depressed letters as at *C* in Fig. 7, so that the paint will not be wiped out of the cuts. The width of cut for such applications may vary from 0.005 to 0.030 in. Molds can be engraved by hand before hardening, or etched by the photoengraving process after hardening to give attractive and lasting ornamentation in many forms.

Molded Threads Often Used

Bottle closures probably are the most familiar examples of threaded plastics molded parts. These usually have a special, coarse, easily-molded thread. It is possible to mold standard V-type threads, both inside and outside, if conditions warrant. Obviously, this proc-

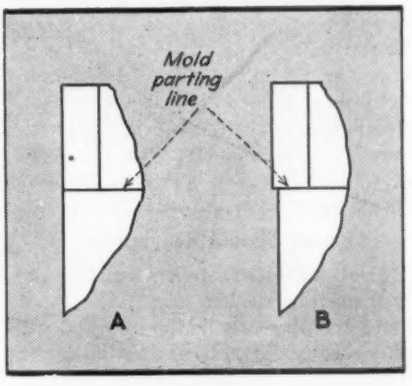


Fig. 3—A mold parting line flush with the surface of the part, as at A, *makes it difficult to remove the flash without scoring adjoining surfaces. When the parting line is projected above one of the adjoining surfaces, as at* B, *the flash is relatively easy to clean*

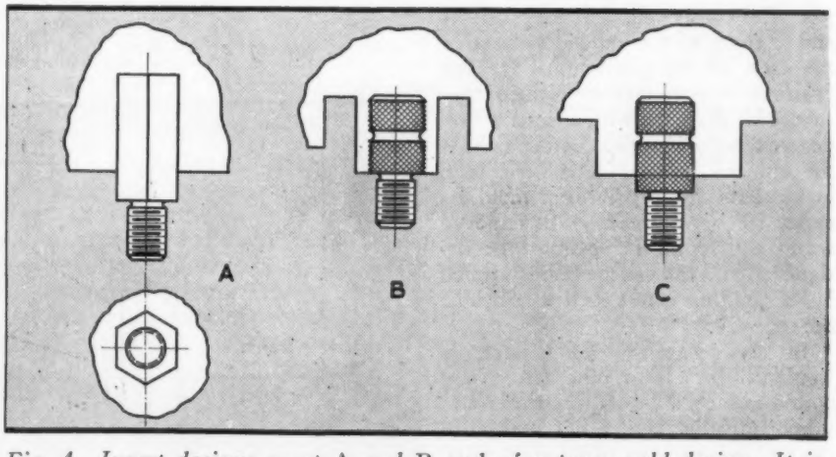


Fig. 4—Insert designs as at A *and* B *make for poor mold design. It is difficult to produce a satisfactory hexagonal hole in the mold for the design at* A, *while a thin wall of compound around the insert, as at* B *provides insufficient anchorage. Where sufficient compound surrounds the insert, as at* C, *cracks are prevented*

ess adds to the cost of the molded part because the part cannot be extracted from the mold as easily, and because of additional hand operations required. For instance, a part in which a threaded hole has been molded can either be unscrewed from the mold, or provision can be made to have the thread-forming portions of the mold extracted with the part and then unscrewed. Outside threads can be molded in a split die. Small holes also may be tapped, but the threads usually are not as strong as molded threads. It is not wise to attempt to use more than 32 threads to the inch for either molded or tapped threads.

A large number of devices, both old and new, are available for use in fastening component parts into a complete assembly. These devices have not been developed exclusively, or primarily, for plastics, but fit into the modern picture of quick and inexpensive assemblies, at the same time providing lasting service and security. Among the quickly-applied devices now in use are self-tapping screws, drive pins and screws, cross slot or recessed head screws, speed nuts, speed clips, vibration-proof screws, the aero-thread screw, ball chain, and the newly developed spline lock.

Hinges can be applied to molded parts, if desirable, although they increase the cost of the part. In general, three types of hinges are used. These are the piano, the pin, and the spring or spring-and-pin hinges. Piano-type hinges do not require any elaborate provisions in the molded parts. Holes usually are drilled and the hinges fastened by means of drive pins, drive screws, or self-tapping screws.

Pin-type hinges are not expensive because they involve only easily molded provisions in the molded parts. A lip or projection is molded on one part, usually the cover, and a slot is molded into the other part. In the case of a molded box, a hole is drilled through the side of the box in the proper location, a like hole is drilled in the cover lip, and the assembly is completed by forcing a metal pin through these holes.

There are two spring-type hinges in common use today. Both require relatively simple recesses in the molded parts, into which small spring-steel clips are sprung. These springs hold an assembly firmly closed, and also will hold a box lid open. Their assembly is simple and quick.

The finish of a molded part should conform with its application. If a product depends upon its appearance for sales popularity, the finish is most important. On the other hand, a part which does not meet the public eye, and which does not require a highly-polished surface for its proper operation, can have a relatively rough surface without injuring appearance.

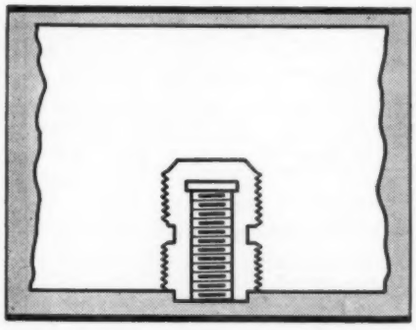


Fig. 5—Here is a good insert design. Knurling and the undercut provide good anchorage, while the butting shoulder flush with the surface of the molded part prevents leakage into the threads

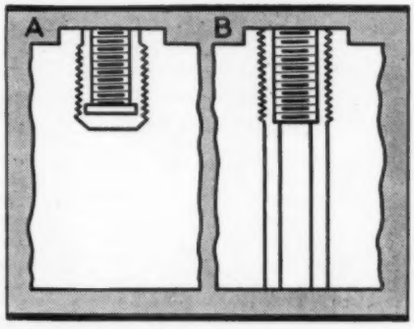


Fig. 6—Insert construction shown at A is not recommended, since the molding compound is likely to leak into the threads. A through insert, as at B can be used, but requires extra cleaning operations

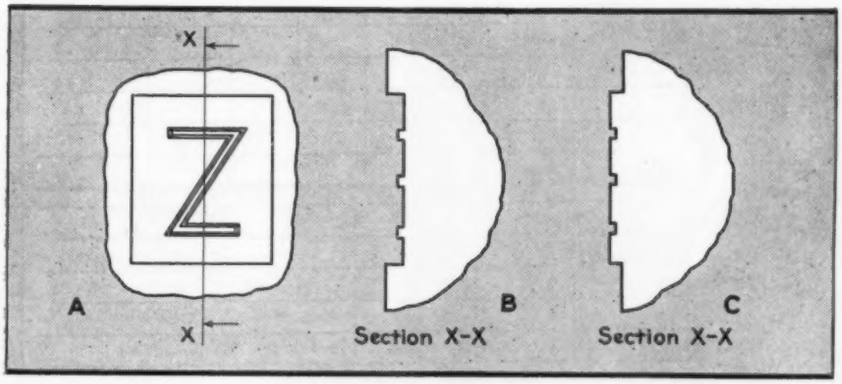


Fig. 7—Letters frequently are molded on the surface of plastic parts, as at A. A raised letter on a recessed background, as at B, is the easiest to produce. Depressed letters on a raised pad, as at C, are expensive in machined cavities, but can be produced easily by hobbing

Polished Surfaces Expensive

Plastics molded parts faithfully reflect the surface of the mold. Therefore, a high surface finish is primarily a question of getting the highly polished surface produced on the steel mold. The higher the polish, the more hand work necessary, and the higher the cost. Chromium plate over a highly polished mold surface will greatly lengthen the life of the mold and add somewhat to the luster of the surface produced.

The shape of the part, the kind of compound used, the mold design, and the heating of the mold are some of the other factors which affect the finish of the molded part. It is necessary that all of these factors be considered in order to obtain the best results.

Within recent years, methods have been developed for applying almost any desired form of decoration or ornamentation to plastics molded parts. The methods which have been accepted are either less expensive to use than engraved molds, or they produce effects which cannot be duplicated in the mold. Examples of these processes are machines which stamp or cut letters in molded parts, specially developed decalcomanias, printing machines and special fast-drying inks which cling tenaciously to smooth molded surfaces, stamping machines, hot-die roll-leaf stamping which bonds the metallic leaf on the surface of the thermosetting materials and embeds the lettering or design in thermoplastic materials, metal inlays for striking effects, halftone offset lithography, and finally metal plating of molded plastic parts. In cases where it is desired to cover or disguise molded parts, the molder now has available a practically complete line of paints which have been developed for use with the common plastics materials. By applying one or more of the processes mentioned above, it is possible to get almost any decorative effect desired on the finished part.

Small Shop Stock Control

Here is a simple stock control system which keeps the stockroom well ahead of anticipated requirements and still permits manufacture of parts in lot sizes that give low shop costs

EMPLOYING BUT 200 MEN, the George Gorton Machine Company has to work efficiently to turn out the large dollar volume it averages each month. Keeping track of more than 6,000 different parts and having them ready for assembly in machines when needed is a large factor in getting such efficiency. Formerly parts were manufactured in quantities which were felt to be an economical run. This resulted in an unbalanced inventory and in event of redesign there was the possibility of many obsolete parts on hand.

A stock control system for parts and raw materials recently was established which provides a balanced inventory. Since parts are kept in stock in sufficient quantities for about three months' operation, it is still possible to produce them in economical lots. Part of the recently built addition to the plant is used for a finished parts stockroom, placed adjacent to final machine assembly and the shipping floor.

Form Lists Production Data

In the modified Kardex system employed for stock control, all orders originate in writing from the main office where they have been checked by the engineering department for correct listing of standard and special parts. The $8\frac{1}{2}\times11$-in. form shown in Fig. 1 provides the production department with necessary data to order and schedule the parts required. It later serves as a shop order for the final assembly of the machines. This form has been designed especially to show specifications for standard and special units, and takes care of practically all variations possible in the standard lines of machines.

Parts required for final machine assembly are listed on the $8\frac{1}{2}\times11$-in. schedule requirements sheet shown in Fig. 2. All columns of this sheet which apply to the standard major assembly are filled out in advance and the form is run off in any desired quantity on a Ditto machine. Specific data as to number of parts required for any individual order, and the date they will be needed, is filled in by the clerk in the production department.

The data on number of parts then is posted on the two forms shown in Fig. 3 in the Kardex file in the production office. The number of parts required is entered under the schedule of requirements column on the lower card. The balance in the finished stock column on this card indicates what number of parts must be ordered and scheduled through the plant. A green marker on the lower edge of the card indicates an order in process and the date it is to be completed. An orange colored adjustable strip indicates how many months stock of each part is on hand, a blue strip indicates obsolete parts maintained in stock for repairs, while a block and white marker is a warning that the particular part requires considerable time to make or secure. This lower card shows the name of the part, the material from which it is made, and lists the models for which it is required and the number of pieces needed for each model. Vertical columns show scheduled requirements, the quantity on

Form 1570

FOR _____ No. _____ Our No. _____

_____ No. _____ Serial _____

_____ Model _____ Metric / Standard _____ Super Speed Mill

Table _____ Hand / Power Feed _____ Table Hd. Fd. Shaft _____ Bearing _____

Knee Gears _____

Spindle _____

Spindle Speeds _____ Speed Plate _____

Pulley _____

Motor Bracket _____ Clamp Ring _____

Power Feed to Spindle _____

Pump _____

End Measures and Indicators _____ Scales and Verniers _____

Automatic Reversing Dogs _____

Duplicator Table _____ Tracer Head _____

OTHER EQUIPMENT

Grinder _____ Head _____ Pedestal _____ Collet _____

Circular Table _____

MOTORS:	MAKE	SPEED	H. P.	VOLTS	PHASE	CYCLES	R. P. M.	FRAME
Spindle								
Knee								
Pump								
P. F. Spindle								
Grinder								

STARTERS:	MAKE	NUMBER	PUSHBUTTON	ELECTRICAL NOTES
Spindle				
Knee				
Pump				
P. F. Spindle				
Grinder				

(FOR OTHER ACCESSORIES SEE OTHER SIDE)

Fig. 1—Serving both as an authorization to the production department to order and schedule parts and as a shop order for machine assembly, this form shows standard and special units needed for a given machine

FORM 1576

GEO. GORTON MACHINE CO.

SCHEDULE REQUIREMENTS PAGE PAGES

OUR ORDER No. NAME

MACHINE

AMT. REQ'D.	PART NUMBER	NAME	BIN NUMBER	MATERIAL – PATTERN NUMBER	DATE DUE	ORDER PURCH. DEPT.	ORDER ON SHOP

Fig. 2—All parts needed for a complete machine are listed on this sheet. For standard units, this sheet can be filled out in advance, except for quantities and dates, and a supply of copies run off

order, the amount of finished stock on hand, and the consumption of the part during each month.

The upper card in the Kardex file shown in Fig. 3 is a record of castings and other purchased materials or parts. The Purchasing Department is notified when this card indicates a need for more parts in a certain category. Like the first form in this file, this form gives the name of the part, the material it is to be made from, the pattern number and the models for which the part is required. Vertical columns show scheduled requirements, purchased orders, and quantities in rough stock, as well as monthly consumption. In both of these forms, requirements are scheduled against definite orders for finished machines and the shop or purchase orders on which new supplies are requisitioned.

When the finished stock balance of any part reaches the minimum, a shop department requisition order, Fig. 4, is made out in triplicate for the individual part. The original white copy of this form, protected by a cellophane holder, goes to the shop with a blueprint of the part. These must stay with the job until all shop operations have been completed and the parts have been placed in the stockroom. The stockroom keeper's signature on this white card, with the amount received, is notice to the production office that parts are completed and in stores. The yellow duplicate goes to the cost department at the time the order is originated, and authorizes the cost department to set up a folder for receiving time and material slips on the job. The pink

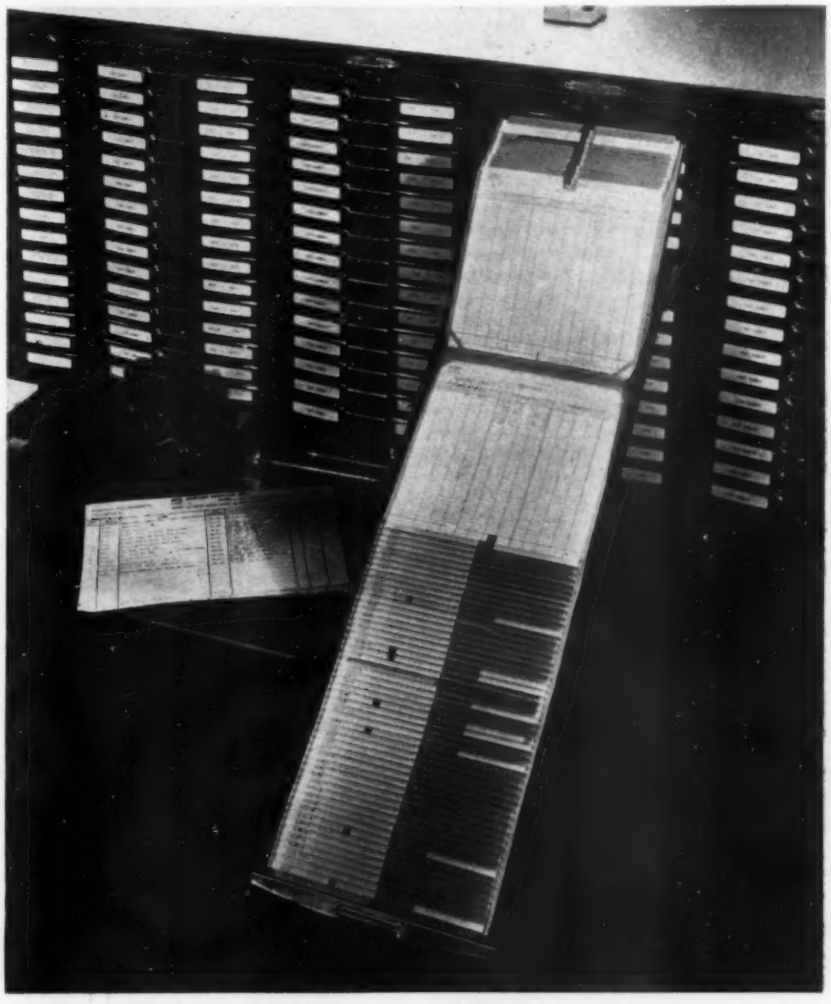


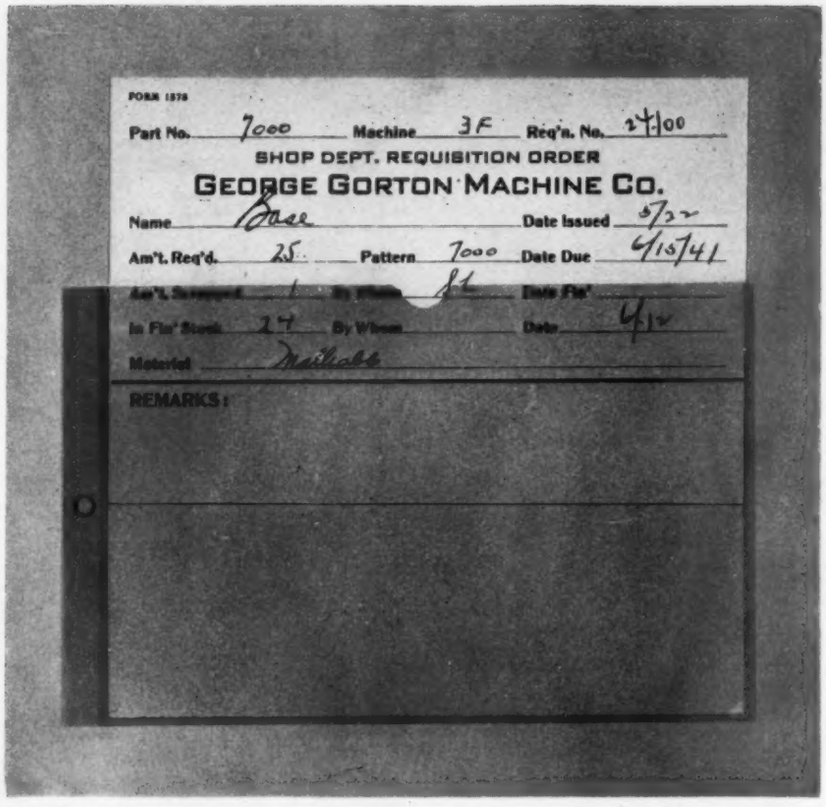
Fig. 3—A record of scheduled requirements and of finished stock on hand is maintained for each part in this Kardex file. Result is a balanced inventory of needed stock parts

duplicate is filed in the production control office for reference.

The form shown in Fig. 2 serves as the order for final assembly of the machines and the required parts to be requisitioned from the stockroom, which is near the assembly floor. Withdrawals from the stockroom are listed and forwarded to the production office, where they are posted in the Kardex file, Fig. 3, so that a running balance is maintained on all stock items. Stockroom bins, which reach from floor to ceiling, are lighted by Cooper-Hewitt type fluorescent lights, and the grating which serves as a second floor for the stockroom permits passage of light to the lower level.

Locations of parts in the stockroom are recorded on a visible file, Fig. 5, according to part number. The stockroom clerk thus quickly can locate any one of the more than 6,000 parts in his charge. Aisles are lettered from *A* to *P*, first floor levels from 1 to 15, second floor levels from 16 to 25, while location along the aisle is indicated by piece number. Drawers are further indicated by a letter placed at the end of the complete location number. For convenience, obsolete or infrequently used parts are placed on the second floor and are signaled with a blue tab.

As shown in Fig. 6, the stockroom attendant is provided with a convenient pad holder which he uses as he checks the stock required on a particular order. This photograph also shows the method of supporting the second floor grating on the stock bins. In this stockroom, parts with ground or polished surfaces are protected by wax paper or special tape, and are kept separated in wood pigeon-holes. Spindles are held upright in special drawers with drilled holes in the wood top. Graduated collars are stacked on wood pegs mounted on wood drawers. When parts have been checked from stores, forms are returned to the production office where withdrawals are noted on the Kardex file cards, and balances are kept up-to-date. Raw material stores and small parts inventory also are recorded in an assigned space in this file.


FORM 1878

Part No. 7000 Machine 3F Req'n. No. 24100

SHOP DEPT. REQUISITION ORDER

GEORGE GORTON MACHINE CO.

Name Baer Date Issued 5/22

Am't. Req'd. 25 Pattern 7000 Date Due 6/15/41

Am't. Supplied 1 By Whom [illegible] Date Fin'

In Fin' Stock 24 By Whom Date 6/12

Material Mallable

REMARKS:

Fig. 4—Protected by a cellophane holder, this shop requisition accompanies each order for parts from operation to operation until the job is completed and the parts are delivered to the stockroom

Fig. 5—In the stockroom, a visible file shows the bin location for each of the more than 6,000 parts kept in stock at all times

Fig. 6—The stockroom attendant uses a convenient pad holder when assembling an order from parts stored in these Lyons bins

Spun Heads Save Time

BY J. J. MOLETTE AND J. C. BOHAN, SOUTH PHILADELPHIA WORKS, WESTINGHOUSE

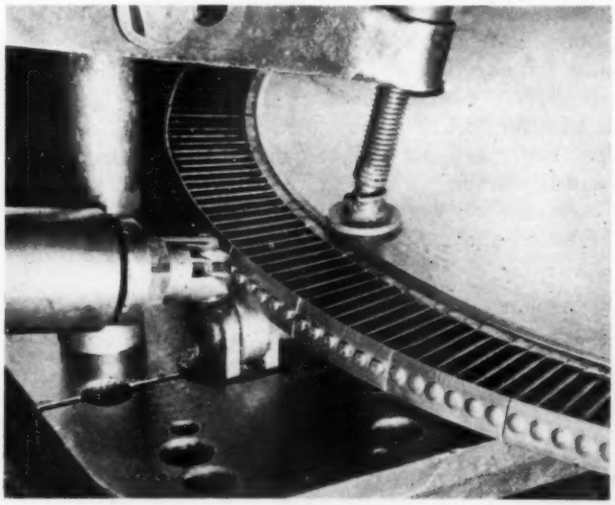
Parts from scrapped machines, plus a little ingenuity, have been assembled to form a hybrid spinning unit that has cut heading time by 65 percent

A HIGHLY EFFICIENT rivet spinning machine recently was improvised for fastening shrouds on turbine rotor disks and stationary blade segments by forming a button-head on the end of each blade. Formerly this operation was performed manually by an operator striking a riveting tool with a hammer. This required considerable skill and some physical effort on the part of the operator. Moreover, it was not conducive to maximum efficiency nor to the uniformity so essential in the manufacture of high-grade machine shop products. There always was present the hazard of indenting the shroud strips and overworking the blade stock, thus weakening the assembly. Spinning machines were obtainable on the market, but it was decided that a machine to overcome the individual spinning problems on this particular type of work should be built from available standard parts taken from scrapped machines.

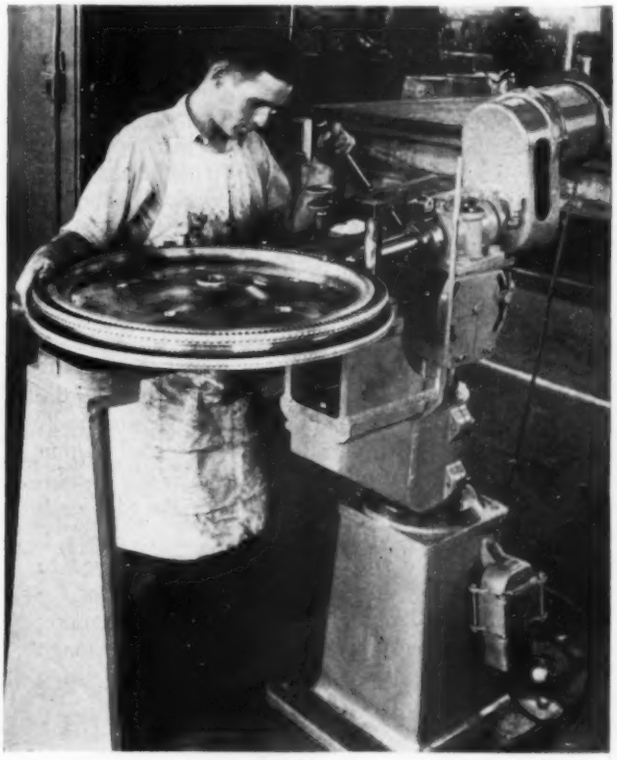
A scrapped cutter grinder, a discarded high-speed milling head, some steel (boiler plate and bar stock), and an idea created a hybrid at a relatively low cost in labor and material. The spinning machine was completed by assembling at the end of the horizontal spindle twin rolls, mounted on a pin, which are free to turn on their own axes as they revolve with the spindle. The spindle is driven by a ½-hp. motor. The bed of the machine is so constructed that it is possible to spin rivet heads on blade pegs assembled on the outside diameter of a rotor disk, the inside diameter of a stationary blade segment, and on rotor disks which have been assembled on the rotor shaft. The latter set-up effects considerable savings, inasmuch as it eliminates the necessity of removing the rotor disks from the shaft assembly.

How It Works

Rolls on the spindle are pressed against blade pegs by sliding the adjustable revolving spindle forward by hand lever. Rivet head is formed by the flow of metal under rotation of the rolls. Spindle stop at the end of the cross slide ways insures uniform rivet heads, and also eliminates the possibility of indenting the shroud strips. Adjustable centering fixtures are provided to take care of rotor disks and blade segments of various sizes. The spindle is moved forward toward the work while rotating at 1,125 to 1,575 r.p.m., depending on the size and shape of the rivet head to be formed. Final indexing and setting of the pegs is obtained when the rolls actually touch the peg and spinning is started. The work is clamped in place and released for each blade setting by means of a cam operated clamp, which works automatically in conjunction with the hand operating lever.



Roll shape, type of rivet head formed and method of clamping work while spinning are indicated in this close-up view. Note support roll directly under shroud plate of the turbine rotor disk



Uniformly spun rivet heads quickly are formed with this hybrid spinner. Developed especially for work on turbine rotor disks and stationary blade segments, this unit has possibilities on other products

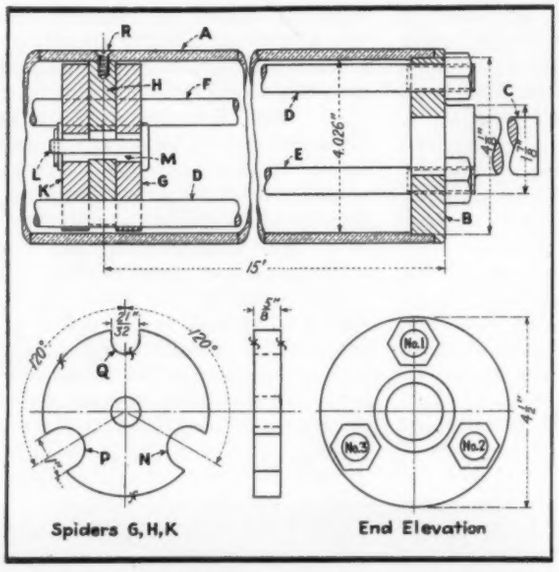
IDEAS FROM PRACTICAL MEN

Long Roll Stiffened with Truss Rods

BY MARTIN H. BALL

The bending roll *A* shown in the drawing is 4½ in. diameter and 30 ft. long. Service requirements demanded that it be of light weight, but yet as stiff as possible. Consequently, it was designed so that it could be stiffened with truss rods.

The body of the roll, made from standard 4-in. steel pipe, was fitted with cast-iron heads *B* carrying steel trunnions *C*. The roll *A* was built up by welding together several lengths of pipe after which it was bored to size to receive heads *B*, and faced accurately for seating the flanges.



Long thin bending rolls can be stiffened with spiral truss rods located by loose fitting spiders centered in the roll

Three ⅝-in. truss rods *D*, *E* and *F* pass through the roll. Their overall length is sufficient for drawing the heads *B* into the tube with the nuts on the truss rods, ample allowance being made for the threaded portion so that it can be cut off after assembly since it is difficult to determine the correct length of the rods until the heads *B* are pulled into position.

Three cast-iron spiders, *G*, *H* and *K* are used to locate each of the three truss rods in the center of the roll. These spiders are tied together with retaining pin *L*, a washer and cotter pin which are loose enough to permit sliding the spiders freely when adjusting the truss rods.

The holes in the center of the spiders are made sufficiently large for adjustment of pin *L*, as shown as *M*. The two large slots *N* and *P* are also large enough to permit adjustment of the rods. Each rod is located by the small slot *Q* in each individual spider, and is kept properly spaced from the other truss rods by its location in the larger slots in the other two spiders.

The truss rods should be numbered at each end, as shown in the end elevation drawing, to simplify aligning and locating the ends during assembly. These rods cross and bear against one another at a point about midway between the spiders and the ends of the roll.

The three spiders when assembled with the truss rods lying in the slots, can best be pushed into the center of the roll with a section of pipe. After adjustment of the truss rods for final straightening, the threaded portion beyond the clamping nuts can be sawed off. If a lathe of sufficient capacity be available, a finishing cut should be taken off the trunnions.

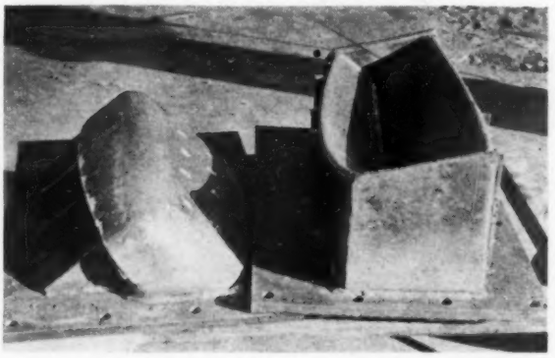
After locating the spiders at the center of the roll, the center spider *H* is drilled and tapped to receive small screw *R* to prevent the spider assembly from slipping and rotating in the tube.

In cases where the greatest bend in the roll is not in the center, the spiders will best serve their purpose located at the point of greatest error.

Forming Dies Built Up From Welded Plates

Both the female and male members of the illustrated forming die were built quickly and economically by arc welding rolled and shaped pieces of plain carbon steel. The die is used to form hot $\frac{3}{16}$-in. plate into the upper radiator shell for a modern industrial tractor.

Both members were made from ¾-in. rolled plates. The male portion of the die also involved pipe sec-



Both sections of this die, used for forming a tractor radiator shell, were built up by welding rolled and formed ¾-in. plates

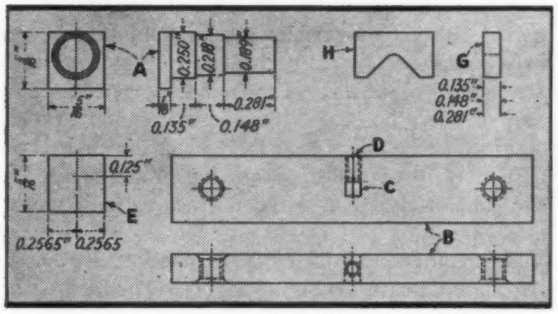
tions to form the rounded edges, with portions of machine-steel balls for the spherical corners. After the parts were welded together, finishing was accomplished entirely by grinding, no machine work being required.

Offset Shouldered Studs Turned in the Lathe

BY J. W. GERDEL

A number of studs *A* were to be made of $\frac{5}{16}$-in. key stock and were to be turned with offset shoulders to the dimension as shown in the drawing. The following procedure was adopted:

A holder *B* was made of $\frac{5}{8}$x1$\frac{1}{2}$x8-in. cold-rolled steel. This was ground flat, and a slightly undersized hole *C* $\frac{5}{16}$ in. square was broached in the center of it.



This holder, bolted to a lathe faceplate, can be centered to turn the offset body of studs to required diameters

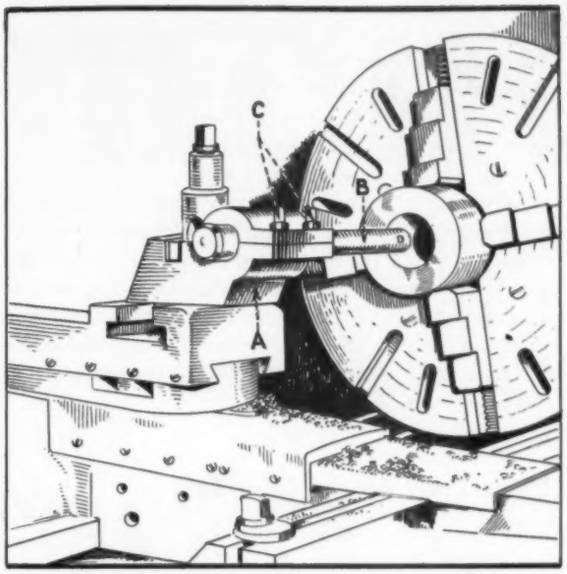
The hole was then squared with the surface of the piece and was made a snug fit for the $\frac{5}{16}$-in. key stock. A $\frac{5}{16}$-in. setscrew *D* was located in the side of this piece to hold the key stock in position. The piece was clamped on the faceplate of the lathe.

A section of the key stock was placed in the holder and the end was faced. It was then removed from the holder and lines were carefully scribed with a height gage as shown at *E*. A centerpunch mark was made at the intersection of the two lines. The stock was replaced in the holder and the centerpunch mark was trued up with a centering rod and indicator.

Three spacing plates *G* were made and ground to the thicknesses shown. A Vee block *H* was clamped to the front way of the lathe to act as a stop for the headstock end of the carriage.

After locating the stock suitably in the lathe so that all of the shoulders could be turned, the end was faced. With the carriage in this position the stop was set on the front way of the lathe, with the three spacers between it and the headstock end of the carriage.

The spacer for the 0.281-in. shoulder was removed and the first shoulder was turned up to the second spacer. The remaining two shoulders were turned in a similar manner. The stud was then cut off and the operation was repeated for the next one. By this method all of the shoulders were turned to the exact length.



This rigid boring bar holder was designed to machine locomotive main and side-rod brasses and valve bushings in two cuts

Tool Holder for Heavy-Duty Boring

BY ARTHUR HAVENS

The boring bar holder shown in the illustration was made for heavy-duty turning of locomotive main and side-rod brasses. In boring long bushings and brasses, the rigid construction of the holder will keep the boring bar from springing, and the work can be bored in one or two cuts rather than three or four required with the light holder used previously. In large central repair shops this results in considerable savings.

The holder *A* is machined from a solid block of steel, and is drilled to drop over the toolpost. A sliding block, pinned into the slot of the holder, fits into the toolpost. When the toolpost screw is tightened against the sliding block, the fixture is held tight on the lathe carriage. The holder *A* is slotted so that the boring bar *B* may be adjusted or removed by manipulating the capscrews *C*.

Duplicating Threads with a Spring Caliper

BY H. B. MARTIN

When called upon to duplicate a threaded part, as often occurs in repair work, a practical way to make the measurement for depth of thread is with an ordinary outside spring caliper. But use a caliper having flat widths at the points of the legs equal to the width of the top or bottom of the thread, and with the sides of the legs tapered to an angle that will allow the caliper to adjust itself without wedging in the thread grooves. A caliper with points having an included angle of 52 deg. and a flat at their points of 0.015 in. gives very satisfactory results when used on threads from $\frac{1}{2}$ to 1 in. diameter.

When duplicating a thread that has become worn,

there is generally some portion of it in good condition which may be used for setting the calipers. Even if it is worn some, the points of the calipers will bear near to the bottom of the thread where usually the minimum of wear has occurred. This caliper can also be used to advantage when set to a tap.

While there is no intent to discourage the use of the three-wire method of measuring with a micrometer when and where the equipment is available and understood, one must know the reading required, or the sample to be duplicated must be a practically perfect thread. On the other hand, the method outlined above is easier and quicker and meets the requirements in most instances.

Motion Study Reduces Labor Cost

BY O. W. HABEL

The machine shown in the illustration is used for the dynamic balancing of propeller shafts. The balance of the shafts is indicated by sine-wave charts which are protected by the hoods shown mounted at each end of the machine. When originally delivered to our plant, the chart protectors at each end of the machine pointed straight out toward the operator with the sine-wave charts parallel to the shaft being balanced. Therefore, when the operator desired to read the charts and check the balance, it was necessary for him to walk from one end of the machine to the other, a distance of 8 ft.

After making a motion study on this machine, the chart protecters were turned in 45 deg. The operator can now read both charts from the middle of the machine, which is his natural working position. Keeping his movements within normal working space resulted in a labor saving of four per cent. This is but one economy effected in our plant by motion studies.

The charts on this machine, originally parallel with the shaft, were turned in 45 deg. Result—a four per cent labor saving

Setting Walschaert Valve Gear

BY E. G. EKLUND

It is often contended that valves cannot be set propperly without putting a locomotive on rolls. This is true with Stephenson valve gear for at least two reasons: (1) Eccentrics cannot be located readily to provide the proper lead without dead centers, and (2) it is necessary to take the cylinder cut-off since adjustments are frequently required after squaring the valves "in the corner" to obtain proper steam distribution at working cut-offs.

Neither of these conditions exist with Walschaert valve gear because eccentric cranks can and should be located according to drawings, and it is not necessary to take cylinder cut-off.

Before proceeding to discuss setting Walschaert gear, it is well to consider several important factors over which the valve setter has not control, but which are of vital importance. These are the proper application of valve bushings, the proper location of port holes in the bushings, and the correct dimensions on the valve, all of which govern the proper steam lap and exhaust clearance, without which valve setting is of no avail.

Before attempting to set valves, check and if necessary correct the following items: (1) The back-set of the link tails, which must correspond to the drawing to effect proper correction for angularity, (2) the length of eccentric cranks, and (3) dimensions of lap-and-lead levers and union links. All these dimensions can be obtained from engineering drawings.

After applying links, link blocks, radius rods, radius-rod lifters, lap-and-lead levers and union links, place the radius rods in the center of the links, making adjustment to the radius-rod lifters if necessary to center the link blocks. Then move the valve crossheads to obtain all bumping marks, and tram the valve stem at each bumping mark. Finally, make necessary alterations to valve stems or radius rods to square the tram marks with port marks.

Locate the eccentric cranks, using the valve-gear drawing to obtain precisely the correct degrees throw.

When the main rods have been applied, set the eccentric rods and trail the locomotive about half a stroke while tramming the steam admission and exhaust points on the valve stem. Change the length of the eccentric rod if necessary to square the tram marks so obtained with the port marks. The valve setting is now complete, and it will provide the best possible valve vents of which the design is capaole.

Squaring the radius rod to the valve-crosshead bumping marks is preferable to squaring with the main rods up because it is the equivalent of squaring with the main rods adjusted perfectly for length, which condition will prevail periodically during service of the locomotive between shoppings.

Locating the eccentric crank to drawing specifications is preferable to any other location since it is the only location at which the valve gear will function as designed.

Armament

SECTION OF AMERICAN MACHINIST

WRIGHT TURNS TO LINE PRODUCTION

By P. W. BROWN

Assistant Works Manager, Wright Aeronautical Corporation

BY ADOPTING the "in-line" principle of mass production, and by installing specially designed multiple-tooled machinery, Wright Aeronautical Corporation has found it possible to increase output at Paterson, New Jersey, almost six times while floor space has been expanded only about three and a half times, and manpower has been tripled. Machining lines have been arranged so that parts progress directly from one operation to the next; assembly lines have been shuffled to permit the assembly of engines in progressive stages, one being assembled every 24 minutes. The working force in the Paterson area has been enlarged from 5,175 persons in 1939 to more than 17,000 at present. More than half of the new machine operators have come into the organization as learners in a carefully arranged training program.

Climaxing a long period of gradual growth during which manufacturing areas gradually were expanded to meet the needs of the growing aviation industry, the present record has been made possible by the expansion of floor space in Paterson from one plant of 900,000 sq.ft. in September, 1939, to five plants now totalling 2,856,900 sq.ft. When the new Cincinnati factory is completed, the company's manufacturing space will total approximately 4,976,900 sq.ft. The expansion in Paterson of nearly 2,000,000 sq.ft. has been obtained both by new construction (including a new 480x960 ft. modern single-floor machine shop, a new 200x700 ft. magnesium foundry, and additions to assembly, test and aluminum foundry areas) and by taking over two large and one small silk finishing plants in nearby communities. Some 2,000 machine tools of practically all classifications have been purchased and installed in the various manufacturing areas in the Paterson plants since World War II started with the shelling of Danzig almost two years ago.

This tremendous expansion has, of course, presented major problems in the procurement of floor space, the purchase and delivery of manufacturing equipment, and the employment and training of new personnel. In addition, it has placed a heavy burden on the production engineering department, as complicated mass production problems involved in the manufacture of the 1,700 hp. Cyclone 14-cylinder engine, which involves 8,500 separate parts requiring over 80,000 machine operations and more than 50,000 inspections, have had to be solved in a relatively few months. Production and tool engineers have been called on to establish production layouts and design complete new tooling set-ups without loss of time. As a result of this work, these engineers have developed methods of high production for the Paterson plants which are being expanded into the mass production facilities to be installed in the Cincinnati plant before the year is out.

The increased volume going through the manufacturing department now makes it possible to set up one

Fig. 1—Each of these Fastermatic turret lathes is set up for a separate operation on a crankcase section. In this group each operator takes care of two of these semi-automatic machines

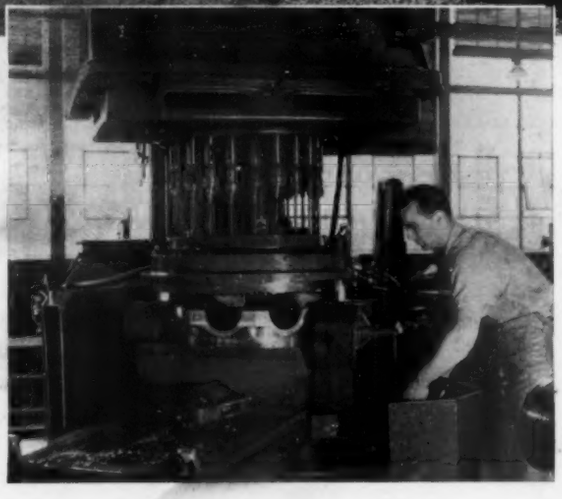


Fig. 2—This 21-spindle Natco drill press is set up to drill, rough ream and finish ream the seven leg holes in aluminum crankcase sections for the Cyclone-14 engine. To insure accuracy of alignment when the three sections are joined together, all three sections are drilled in this same set-up

or more machines for each individual operation. This reduces expensive set-up changes which require the employment of highly skilled set-up men, and materially reduces the chances for errors in set-up which can lead to high scrap losses. With the present high production volume, it is rare that a new operator is called on to perform more than one operation. Consequently, the training period can be shortened materially, and most new men are allowed to go "on their own" after a few weeks spent as an observer with an experienced operator. Each operator is provided with a set of foolproof gages for checking the setting of his tools, as well as the accuracy of the finished piece. Efficiency of the training program, and of the tools employed, is proven by the fact that scrap losses now are only slightly over the lowest percentage attained in 1938 and 1939, when practically every employee was experienced.

Special care has been taken in the design of machines and tools to insure that location of the part is positive. In many cases the tools are interlocked with the operating circuit of the machine, so that the cutters cannot be rotated nor advanced if the part is not properly located and clamped. Further, cutting tools are properly guided, and each machine is set-up to operate at the correct speed and feed. While it would have been possible to increase production by duplicating several times existing processes and equipment, such a course would have required the employment of a higher percentage of skilled men, and would have called for many more machine tools and acres of additional floor space. By restudying every operation on every part, and in many cases revamping entirely the method of fabrication, it has been possible to adopt the most modern methods of producing the many parts

that go into aircraft engines. In many cases now, one machine will perform operations formerly done in several machines with greater accuracy and with savings in time which are reflected in increased production schedules.

During the early stages of the expansion program, Wright's management decided to purchase a larger portion of the parts that go into the engine. In the past, the company's policy has been to fabricate nearly all machined parts for the engine, so as to control quality throughout the machining operations, and to purchase only standard parts and accessories. Where the company previously bought less than 15 per cent of the finished parts for its engines, not including accessories, Wright now is purchasing parts each month that require the work of from 18,000 to 20,000 men in the plants of more than 250 vendors. This increase in purchases reduces the man-power necessary in one locality, spreads the work to experienced supervisory and production personnel in other localities, and often makes use of equipment that would otherwise be idle.

The care employed in the selection of vendors, and in helping them maintain the quality standards demanded, is of particular interest at present because of the large amount of sub-contracting necessary in the current defense program. The company's subcontractors are not chosen because they have bid low on purchase requisitions, nor because they may have unused facilities. A vendor must submit samples of work to show the quality he is capable of producing before he will be considered at all. He also must submit a list of available equipment. If the samples submitted are near the quality standards demanded, his equipment list is checked to see what work he can handle best. Usually, an experienced production engineer visits his plant. Where requirements are met, Wright's purchasing department places an educational order for two or three parts. Before starting work on these parts the vendor is asked to send a key shop man to Paterson to study Wright methods on the part he is to make. Also, the vendor is given an operation sheet showing the sequence of operations and the tools needed to make that specific part. In many cases he also is given copies of tool drawings.

When a vendor finally gets into production, he is visited at frequent intervals by a traveling production engineer who helps iron out manufacturing difficulties. Where there is serious trouble, specialists are sent out from the Paterson plant to help out. Every effort is made to give each vendor the service that any of the Wright manufacturing departments would receive from heat-treating, plating, metallurgical, inspection and other specialists.

Quality of product has been maintained throughout the various stages of the increased production program and the inspection force has kept pace with the increase of productive personnel. Where there were 264 inspectors as of January 1, 1939, the force now totals almost 1,200 carefully trained inspectors. Many of these inspectors spend their time on the manufacturing floor areas and check the first piece produced on each operation before the operator is allowed to proceed with other parts. Thus errors are caught before they result in heavy rejection or rework. The increase in the inspection force has not been easy, as it is almost impossible today to hire men with the background and skill necessary to check many of the precision parts made for aircraft engines. Many of the new inspectors have come up through the vocational school and shop training program and have been upgraded through the inspection groups.

Inspection Instruments in the Shop

In addition to increasing the inspection personnel, Wright has paid particular attention to the provision of suitable inspection equipment throughout the production and assembly departments. Of special interest are the special magnetic testing units developed for such items as cylinder assemblies, steel crankcase assemblies, crankshafts and connecting rods. Also of interest are the large number of electric gages of various types; their use has increased at a more rapid rate than production has increased. At many of the inspection benches optical instruments and constant pressure micrometers, as well as Class A gage blocks are employed for continually checking the gages used to inspect parts.

Even though the total number of parts now going through the production and assembly departments is many times higher than ever attained during a normal production period, the problem of production control has been somewhat simplified. Under normal conditions aircraft engines are made in relatively small lots and practically every lot is different in one way or another from another lot going through at the same time. Hence, under normal conditions, the production control department must keep track of a very large number of different items. The defense program, while it has meant a major increase in number of engines produced, has simplified the problem by reducing the number of sizes and types. Further, the program for enlarging and rearranging facilities in Paterson have made it possible to eliminate various storeroom bottlenecks, and it now is possible to maintain a continuous delivery of material to the production section at a rate that will keep the men working without restricting the space in which they can move about.

The backbone of each Cyclone or Whirlwind aircraft engine is the crankcase. This assembly is made up of two sections for single-row engines and of three

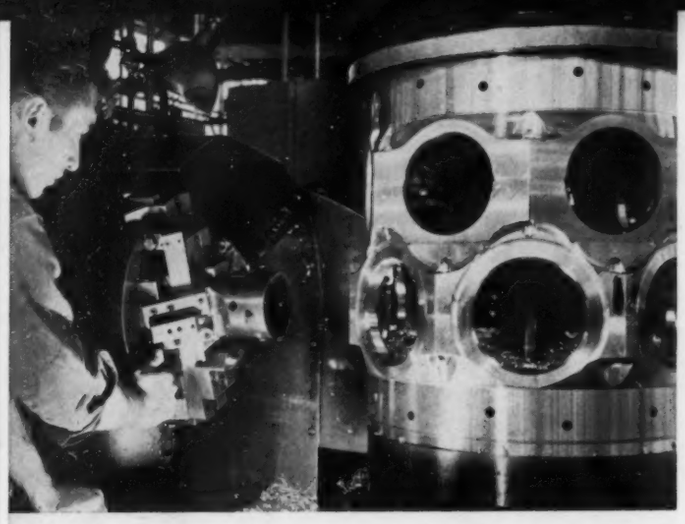


Fig. 3—Special tooling has adapted this Fastermatic turret lathe for boring, facing, and chamfering cylinder deck pads on an assembled aluminum crankcase for a 14-cylinder Cyclone engine

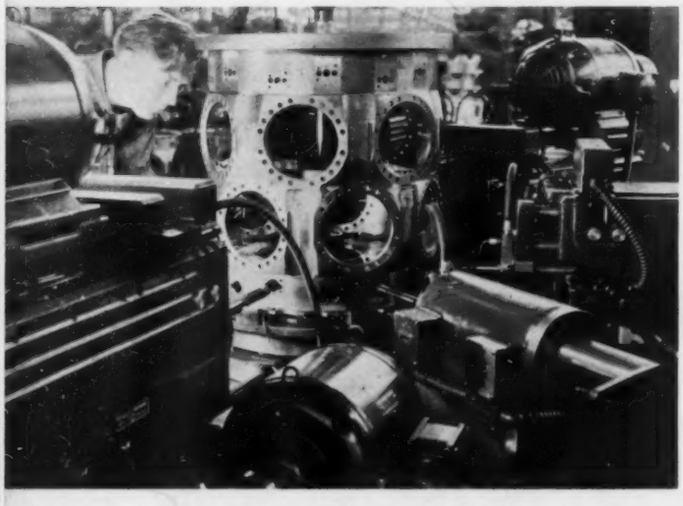
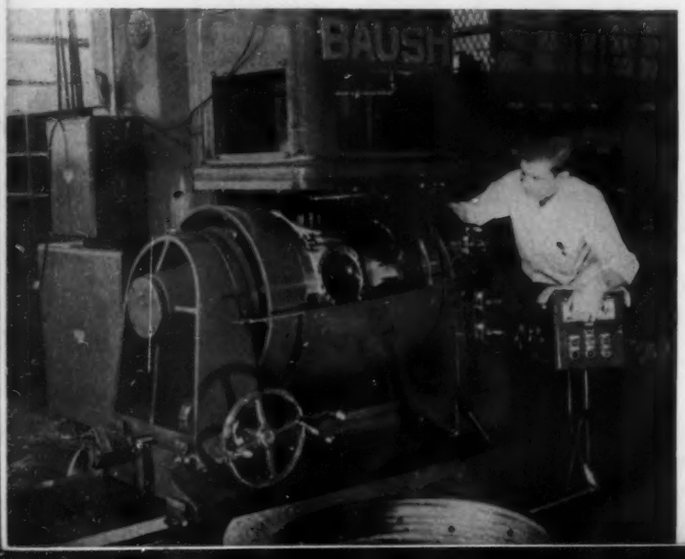


Fig. 4—This station-type Ex-Cell-O machine finishes 28 valve tapet guide holes in the two ends of steel crankcase assemblies for the 14-cylinder engine. The cycle is automatic

Fig. 5—The 20-cylinder hold-down capscrew holes in each pad on the Cyclone-14 steel crankcase are back-counterbored at one time in this machine. The time required to make a 14-cylinder engine is reduced more than 5½ hours



sections for double-row engines. Each of these sections is made from a forging of steel or aluminum, depending upon the engine, and is machined on every surface to insure even balancing of weight and the detection of any flaws.

Prior to assembly of a steel crankcase for a double-row, 14-cylinder Cyclone engine, 46 operations are necessary to complete the front section, 43 operations are required on the center section, and it takes 45 operations to machine the rear section. Following completion of each of the three sections, they are assembled into a single unit, and then 107 additional machining operations are necessary. Where the 14-cylinder Cyclone has an aluminum crankcase, fewer operations are necessary, there being only about 180 operations needed to machine each of the three sections and then to complete the assembled crankcase.

In Fig. 1 are shown a group of Foster No. 4F hydraulic turret lathes used for rough and finish machining the inside and outside surfaces of crankcase sections. Each machine is permanently set up for a given operation on either a steel or an aluminum section, high-speed steel tools being used for the chrome-molybdenum steel pieces and carbide-tipped tools for the aluminum sections. When machining the aluminum sections, the coolant used is a mixture of one part heavy base oil and 24 parts kerosene. For the steel sections, a coolant made up of one part heavy base oil and five parts paraffin oil is used.

Wherever possible, matching holes in different parts which mate together are drilled and reamed in the same jig or fixture to insure absolute uniformity. This is the case in the 21-spindle Natco drill press shown in Fig. 2. Here the front, center and rear sections for aluminum crankcases have the seven leg holes drilled and reamed. Center sections, of course are drilled and reamed on one side, then turned over in the fixture and drilled and reamed on the other side. The fixture on this machine is mounted on rails, so that it can be withdrawn from under the machine head for unloading and loading parts. Each part is centered over a plug in the fixture, then the fixture is moved by a hydraulic cylinder back into the working position and a clamping ring carrying drill bushings is lowered over the work. To insure accuracy, this clamping ring also carries a center plug which must fit into the bearing bore in the center of the piece. The 21 spindles are equally spaced around the hole circle. Every third spindle carries a $\frac{1}{32}\frac{5}{2}$-in. drill, the next spindle to the right in each case carries a roughing reamer and the next adjacent spindle carries a finishing reamer. For the aluminum section, the drills and the rough reamers are rotated at 925 r.p.m, while the finishing reamers rotate at 440 r.p.m. The drills are relieved about five times in the 2½-in. depth of drilling. This can be done

automatically, or by the operator with selective control. Feed is hydraulic and is set at a rate of approximately 0.004 in. per rev. in the aluminum sections.

When the drilling cycle has been completed, the machine head automatically returns to its up position and the operator swings the fixture table 17.143 deg. to the right so as to bring the roughing reamers into position. While either the drills or one set of the reamers is working, the other tools have just enough clearance to pass the milled deck pads around the forging. Upon completion of the first reaming operation, the table again is swung 17.143 deg. to the right to bring the finishing reamers into position. For aluminum sections, fast-helix drills and specially ground reamers are used. Throughout the operation on aluminum sections, a coolant made up of one part heavy base oil and 24 parts kerosene is flooded over the work. A similar machine is used for steel crankcase sections, and on this machine the coolant used is made up of one part heavy base oil and five parts paraffin oil. In both cases, high-speed steel drills and reamers are employed. As in all other machining operations, this machine carries an instruction plate which calls for changing the tools after so many parts have been completed. The frequency of changing has been determined by careful study to insure against the operator permitting a dulled tool to damage the work. As an indication of how important this type of equipment is in the defense program, aluminum center sections now are drilled and reamed in 17 min.; the same job used to take two machines a total of 78 min.

After all operations have been completed on the individual sections which go to make up the crankcase units for single-row or double-row engines, these sections are assembled and then the crankcase goes through another series of machining operations. In Fig. 3 is shown the set-up for the first operation on a crankcase assembly for a 14-cylinder Cyclone engine. Here, each deck pad is bored, faced and chamfered. The crankcase is mounted on a special indexing fixture fitted to the platen of a Foster No. 4F turret lathe, and the tools are mounted on a special carrier fitted to the spindle nose of the lathe. In all, eight tools are used. Similar set-ups are used for steel and aluminum crankcases, high-speed steel tools being used for the steel crankcases and carbide-tipped tools for the aluminum cases. Tools are rotated at 40 r.p.m. for the steel cases and at 250 r.p.m. for the aluminum cases. In each set-up, feed is hydraulic and is adjusted by the set-up man to suit the conditions of the operation.

Floor-to-floor time for aluminum cases is 1 hr. and for steel cases the time is 2½ hr. The hole first is bored to 6.310–6.314 in. with the two roughing tools and the single finishing cutter in the heavy bar extending from the center of the tool carrier assembly. When

Fig. 6—Cylinder hold-down capscrew holes in steel crankcases are tapped rapidly in this single-spindle Edlund machine. The trunnion-type fixture is mounted on a large rotary table

Fig. 7—Steel crankcases for the Cyclone-14 engine must be machined at 28 positions for bolts to hold oil baffles. A tilting jig is used

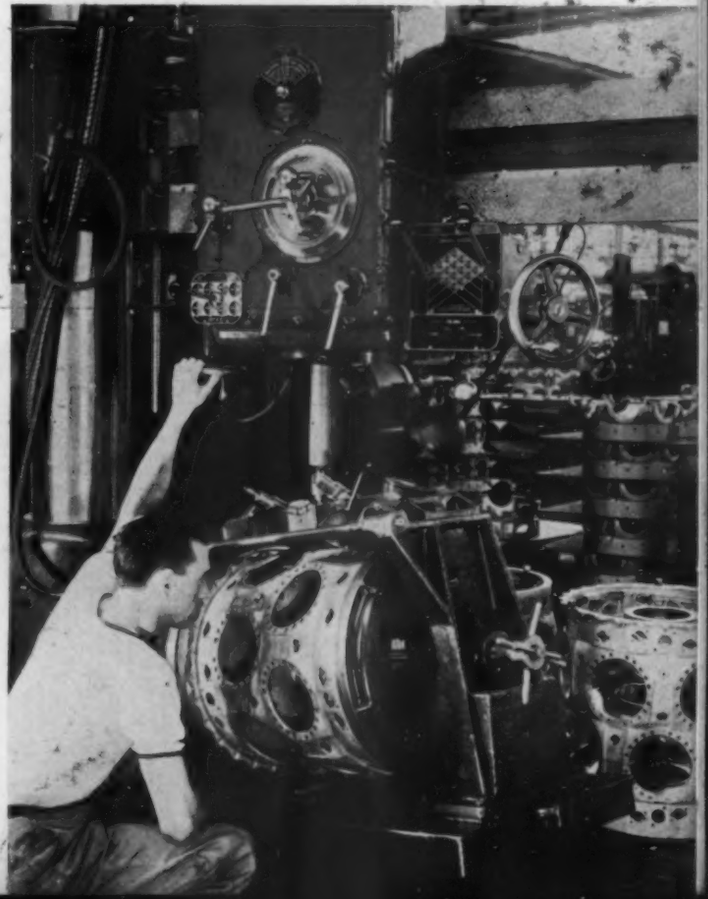


Fig. 9—This automatic tin-plating machine is located in the cylinder barrel machining line, and carries the rough turned and bored forgings through a series of cleaning and plating solutions, then returns them to the loading position at the rate of 32 cylinders per hour

Fig. 8—This battery of ten Mult-Au-Matics has replaced a large group of single-spindle machines formerly used for the rough boring and turning operations on forged cylinder barrels. High-speed steel tools are used at all stations

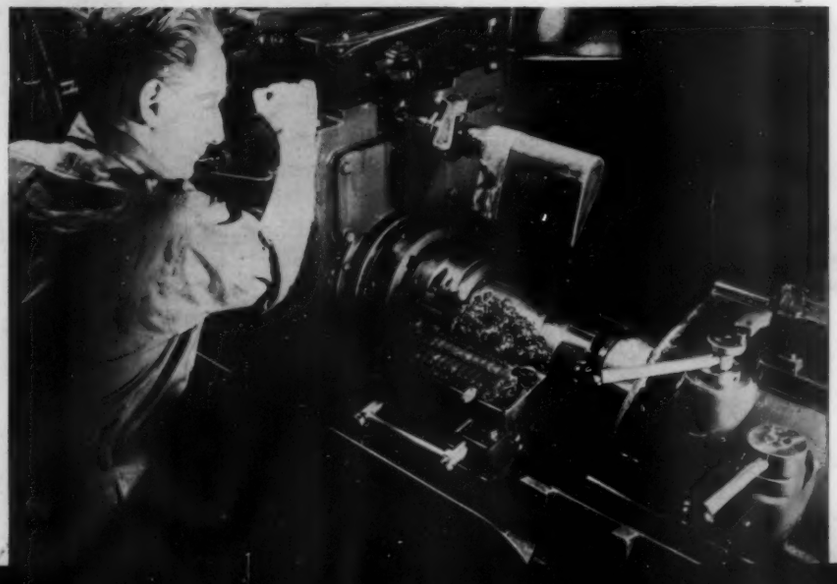


Fig. 10—Much attention has been given to the design of the parting tools used for turning the fins on the outside of the cylinder barrel forging. Feed rate is tapered off as the tools approach the bottom of the cut in this Fay automatic lathe, so as to reduce the danger of damage

the finish boring tool has completed its cut, forward feed of the platen is continued until a positive stop locates the crankcase assembly for the facing and chamfering cuts. Each deck is faced to 8¼ in. diameter and the cut is blended to form a radius at the outer edge. This face must be held within 0.004 in. of a given distance from the centerline of the crankcase. With the platen held against a positive stop, the facing tool is fed out radially while the chamfering cutter is fed in at a 60-deg. angle. At the completion of each pad, the platen is returned to the other end of the bed and the fixture automatically is indexed to bring the next pad into position. After a row of seven pads has been machined, the piece is up-ended on the fixture for machining the other row of pads.

A number of special station-type machines for various drilling, countersinking, reaming, tapping and similar operations have been installed to speed up production of assembled crankcases. One of the most interesting of these units is the special five-head Ex-Cell-O machine shown in Fig. 4. Here valve tappet guide holes at each end of the crankcase are drilled, bored, chamfered, broached and finish reamed. There are two of these holes for each cylinder pad. A preliminary drilling operation at each of these positions is performed in a similar Ex-Cell-O section-type machine before the assemblies are brought to this unit.

The machine shown in Fig. 4 enlarges the center hole of the valve tappet guide group, using a 1-in. diameter three-flute core drill passing through both the steel case and an aluminum clamp ring fitted inside the case. Next station on this machine carries a boring bar with two high-speed steel tips for boring and chamfering the steel case. The third station carries a similar bar with one tip for boring the aluminum clamp ring to a slightly smaller diameter. At the fourth station a formed broach is pushed through the valve tappet guide hole, cutting through on each side into previously drilled smaller diameter holes.

At the fifth and final station, a piloted right-hand helical reamer finishes the valve tappet guide hole to a diameter of 1.0623–1.063 in. When one row of seven valve tappet guide holes has been finished, the assembly is raised or lowered on the fixture for the other row of seven holes at the same end of the crankcase. When these have been finished, the crankcase is reveresd on the fixture and the two rows of holes at the other end are finished. Go and not-go gages are used by the operator to make certain that the work is coming through within the specified limits. A similar machine performs the same operations on aluminum crankcase assemblies and another finishes valve tappet guide holes machined around the periphery of a magnesium nose section made for one particular engine.

After the 280 cylinder hold-down holes have been drilled and chamfered in a special station-type ExCell-O drilling machine, the steel crankcases are delivered to the Baush Type W6 multiple spindle machine shown in Fig. 5 where a back-counterboring operation is performed automatically on 20 holes at a time. This job, particularly slow when done by ordinary methods, used to require 400 min.; now the operator does the job easily in 65 min.

The assembled crankcase is set up in the trunnion fixture when the table is moved out from under the head of the machine. Then the table is moved into working position and the 20 back-counterboring cutters, which are mounted in eccentric holders, are inserted through the previously drilled holes and the holders are centered to bring the cutters into position. These cutters are ground to take a spherical cut as there must be no sharp corners which might be the starting point for fatigue cracks. When the 20 holes in one cylinder pad have been finished, the eccentric holders are moved into the relief position and the head is withdrawn. Indexing from one pad to another is done by hand, and when one row of seven pads has been machined the table is adjusted to bring the other row of pads into position under the head.

Following the back-counterboring operation, the cylinder pad bolt holes in steel crankcases are tapped in the single-spindle Edlund leadscrew tapper shown in Fig. 6. Here, again, the crankcase assembly is located in a trunnion fixture which can be indexed around its horizontal axis to bring each of the seven pads in a row into position under the work spindle. The fixture itself is set on a large rotary table, and is arranged so that the center of each pad is directly above the center of rotation of the table. The table is equipped with ball bearings for easy adjustment. Once a hole has been positioned under the tap, the tapping cycle is automatic. The operator has only to rotate the table to bring each succeeding hole into position, and then to rotate the part to bring another pad into position when one group has been finished. After tapping the 140 holes in one row of seven cylinder pads, the assembly is reversed end for end in the fixture to position the second row of pads. With 280 holes to be tapped in each steel crankcase assembly, and with the 0.438–20 tap rotating at 135 r.p.m., the floor-to-floor time is 250 min. The tap employed has both a roughing and a finishing section, so each hole is tapped only once. The operator is provided with a go and not-go plug gage, and he must check each hole after it has been tapped. Aluminum crankcases have 16 tapered stud holes in each pad, and are tapped in a similar machine. In this case, however, the depth of taper tapping must be held within 0.0005 in. so the studs can be set evenly.

Twenty-eight bolt holes for oil baffle plates must be drilled, spot faced, back-counterbored, countersunk

and tapped in each steel crankcase for a 14-cylinder, double-row engine. This operation, performed in the set-up shown in Fig. 7, is not necessary on aluminum crankcases. The trunnion-type jig is positioned on the table of a 4-ft. arm American "Hole Wizard" radial drill, and in order to speed the operation, a quick-change "Magic" chuck is used to drive the various tools. At each of the work positions, the operator drills a $\frac{1}{4}$-in. hole, reams the hole to 0.272 in., countersinks the hole using a piloted tool, spotfaces a surface $1\frac{1}{16}$ in. diameter and $\frac{1}{16}$ in. deep using a piloted tool, and then back-counterbores the other side of the hole with a spherical cutter. After each hole is finished, the operator rough and finish taps the hole by hand. Ordinarily, the operator will finish each hole complete, then index to the next hole before tapping. After one row of seven holes has been completed, the fixture is tilted to another position to bring one of the other rows into line.

Cylinder Barrels Made from Forgings

A battery of ten six-station Bullard Mult-Au-Matics rough turn, bore and face the Nitralloy steel cylinder barrel forgings. The rough forging weighs 60 lb.; this is reduced to 12 lb. by the time the cylinder is ready for assembly with the cylinder head casting. The first six machines in this line of Mult-Au-Matics, shown in Fig. 8, rough bores and turns one end of the forgings, as well as taking a facing cut across that end. The other four machines in the line rough turn and face the other end of the barrel. Each of these ten machines is 14 ft. high and weighs approximately 15 tons. Time per operation has been reduced approximately one-third through the installation of these units, and a considerably larger floor area would have been necessary had the necessary increase in capacity been provided by duplicating previously used equipment.

Rough machined cylinder barrels are tin plated automatically in a conveyor-type unit for which the loading end is shown in Fig. 9. This plating is applied to localize the nitriding operation to the bore of the cylinder, the barrels being rough ground internally following the plating operation. So close is the control of time and current in this plating machine that it is necessary only to check an occasional barrel with an Aminco-Brenner Magne-Gage in order to insure routine production of satisfactory plated barrels. The crossbar on the conveyor line built into this machine carries two hangers for supporting the barrels during the various cleaning and plating operations. These hangers are gear-driven so as to rotate the barrels while they are immersed in the various cleaning and plating solutions.

Cycle of the automatic tin-plating machine is as follows: (1) load barrels on hangers; (2) transfer barrels to vapor tank for degreasing; (3) rotate cylinders in Bullard-Dunn electric cleaning bath; (4) rotate cylinders in hot water dip and spray rinse tank; (5) rotate cylinders in lead-lined Bullard-Dunn tin plating tank for a flash plate; (6) rotate cylinders in lead-lined cold water dip and spray rinse tank to insure removal of all plating solution; (7) rotate cylinders in Bullard-Dunn electric cleaning solution; (8) rotate cylinders in hot water dip and spray rinse tank; (9) rotate cylinders in cold water dip and spray rinse tank; (10) rotate cylinders in hydrochloric acid solution in lead-lined tank; (11) rotate cylinders in cold water dip and spray rinse tank; (12) rotate cylinders in tin plating solution in glass-lined tank in which cylinders are traveled horizontally; (13) rotate cylinders in cold water dip and spray rinse tank; (14) rotate cylinders in hot water dip rinse tank; (15) rotate cylinders over air blast to dry inside and outside surfaces; (16) elevate crossbars and return overhead to loading position; (17) unload cylinders onto fiber-faced jaws which are closed by the travel of the crossbar against a vertical rod.

Following the tin plating operation, the rough machined cylinder barrels are delivered to a battery of internal grinders where the bore of the cylinder is form ground to take care of the tendency to bell-mouth during the nitriding operation. Also, the bore is slightly undercut opposite the thread position, as shrinking on of the heads tends to collapse the bore of the cylinders. A cam plate on the back of each grinder controls the head for the internal form. A 0.0001 in. dial indicator is used on each machine for continuously gaging the diameter being ground . The contact arm on the indicator has a diamond point to minimize point wear.

Next, the cylinder barrels are nitrided in one of six double-end 150 kw. electric furnaces made by Electric Furnace Company. Each furnace is set into the floor so that the hearth is at floor level, permitting easy handling of the loads when they are lifted by crane to the nitriding pots. Fifty-four cylinder forgings are loaded into each of the three pots at one end of each furnace hearth, then the furnace itself is moved along tracks over that end of the hearth. Each heating cycle includes 10 hr. for bringing the load up to heat, a 35-hr. soak at 1,000 F., and a cooling period during which the load is brought down to about 400 F. During this heating and cooling cycle, the three bells at the other end of the hearth are removed after their loads have cooled to room temperature, and the nitrided cylinder forgings are removed. The bells then are reloaded, ready for the furnace to be moved back into position for heating these three loads.

Cooling fins are turned on the outside of the cylinder forging with 43 separate parting tools that are

Fig. 11—Two plunge cuts are used to grind the skirt, thread and pilot diameters in this three-wheel Norton grinder. These operations formerly required two machines

Fig. 14—Threads at the cylinder head fit on the barrels are ground after having been milled. A Jones & Lamson thread comparator is used to inspect an occasional finished cylinder barrel in order to insure maintenance of correct thread form

Fig. 12—By supporting the work arbor in a hole on the table of the grinder shown in Fig. 11, time required for loading and unloading the work is reduced materially

Fig. 13—Lees-Bradner thread millers are used to machine the special modified buttress thread at one end of each cylinder barrel. Floor-to-floor time is a little more than 10 min. per piece

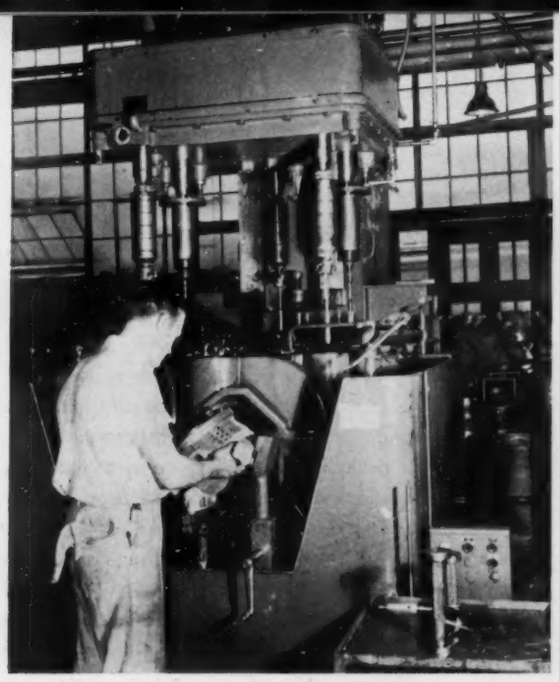


Fig. 15—Intake and exhaust valve guide holes and valve seat counterbores are machined in two Natco five-spindle machines, one machine working on the intake side of the head and the other on the exhaust side

Fig. 16—This ten-spindle special Barnesdril machine automatically drills, reams, countersinks, spot-faces and taps the two spark-plug holes in the aluminum cylinder head

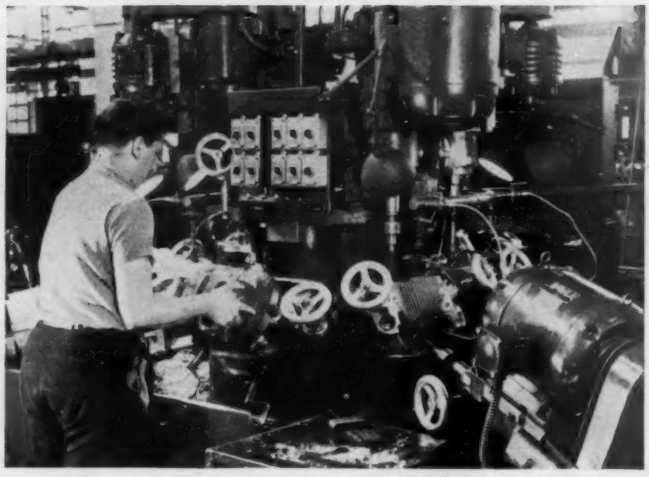


Fig. 17—*(top right)* Interchangeable multiple-spindle drilling, countersinking and tapping heads on this Barnesdril unit machine intake and exhaust port pads

individually ground, then set up in a magazine and sharpened as a unit. The magazine is held with two bolts on the front slide of a 16-in. Fay automatic lathe having an air-operated expanding arbor for holding the work, as shown in Fig. 10. Prior to mounting the work piece on the arbor, a driver is fitted to the barrel on a bench adjacent to the machine. The 41 fins are about 0.020 in. thick and are spaced 0.096 in. apart. Each cut is $\frac{5}{8}$ in. deep, and there is a 0.087 in. radius at the bottom of each groove. A ball-bearing center in the air-operated tailstock is held under pressure against the arbor during the cutting operation. Work speed is 12 r.p.m. Feed starts at 0.0025 in. per rev. and tapers off to 0.0018 in. per rev. as the tools approach the bottom of the cut. Coolant used for this operation is made up one part heavy base oil and one part paraffin oil.

After the cylinder barrels have been finish turned on the outside of the skirt and turned and faced on the flange, the three-wheel Norton cylindrical grinder shown in Fig. 11 is used for finishing the skirt diameter and flange face on one end of the barrel and the thread and pilot diameters on the other end. These surfaces must be ground within ± 0.001 in. of the nominal diameter. The operation formerly required two machines; cycle time now is 11.2 min. using Norton 60-M5 wheels. A special dresser arbor having three diamonds set to match the spacing of the three wheels is used to dress the wheels while in the machine.

The work-holding arbor for this operation has two end plates, each with a pilot diameter, and a taper to center the cylinder. The arbor assembly with the work is carried out on the table of the machine as shown in Fig. 12. One end of the arbor is placed in a hole in the table shown directly under the work in Fig. 11, then the work-piece is dropped over the arbor onto the fixed plate, and the movable plate is dropped into place and clamped. This is a plunge-cut grinder, and the

work is ground in two passes. First, the skirt and flange, and part of the thread diameter, are ground. Then the table is shifted longitudinally and in the second plunge cut the rest of the skirt and the thread diameter, as well as the pilot diameter are ground.

A special modified buttress full-form-fitting thread with a pitch of six per inch is milled and then ground at one end of each cylinder barrel. The thread milling operation is performed in Lees-Bradner thread millers, as shown in Fig. 13, with the work-piece held on cone centers. A ground hob is used, and 9 min. is required for the work to make the slightly more than one revolution required to complete the cutting operation. Both Jones & Lamson and Ex-Cell-O thread grinders are used to finish the full-form-fitting thread milled on one end of each cylinder barrel. In the Jones & Lamson grinder shown in Fig. 14 the work speed is 2.7 r.p.m., speed of the 18-in. diameter wheel is 1,200 r.p.m., and the grinding compound is the same as that used for the fin grooving and the thread milling operations.

Multi-Tool Units Machine Heads

Cast aluminum-alloy cylinder heads produced in Wright's mechanized foundry first are rough bored and faced in a battery of Bullard vertical turret lathes. Then they are delivered to a series of multiple-spindle machines, many of them equipped with station-type fixtures, where the valve holes are drilled and reamed, valve spring holes are step counterbored, valve seats are counterbored and several pads are drilled, countersunk and tapped. The five-spindle Natco unit shown in Fig. 15 drills and reams a valve guide hole on one side of the head and counterbores the valve seat, working from the bottom of the casting. A duplicate machine is installed nearby for finishing a similar hole on the other side of the casting. Drills are changed every four to six hours under normal operating conditions. In this set-up, and in most other machining operations on the cylinder head casting, a sheet metal ring is clamped around the bottom of the fins to protect them from damage. The jig used in this machine has six stations, so that the machine can be kept working while the operator loads and unloads at the front position.

One of the machines that has had the most to do with increasing production in the cylinder head machining line is the multiple-spindle Barnesdril machine shown in Fig. 16. This machine drills, reams, countersinks, spotfaces and taps the sparkplug holes on each side of the casting in one set-up. Around the central column of the machine is arranged a six-station fixture which rotates to carry the cylinder from one work station to the next. The station at the front of the machine is employed for loading and unloading the work in the fixture position, and each of the other stations has a vertical and an angular motor-driven spindle, so that the two holes are machined simultaneously at the five work stations around the central column. Electric controls to the spindles are interlocked so that the machine will not operate unless the work-piece is positioned properly in its station, and a positioning plunger has entered a location hole.

Another Barnesdril unit drills, countersinks and taps stud holes at the intake and exhaust port pads of each cylinder head casting. Two similar machines are provided in order to keep up with production requirements. Since the location, size and shape of these ports vary for the different cylinder heads, interchangeable multiple-spindle heads are employed on these two machines to take care of the different castings. The rotating four-position fixture shown in Fig. 17 is mounted on a horizontal spindle, and is loaded at the top position. The piece then is indexed counterclockwise. The first head drills the holes, the next countersinks and the third taps. Production again is governed by the ability of the operator to keep the machine fixture loaded.

Hall planetary millers with special hobs perform two operations on the cast aluminum cylinder heads before they are assembled with the cylinder barrels. In the first operation, an undercut is milled in the thread bore to the diameter at the root of the thread, then the head is transferred to the second planetary miller where internal threads in the base of the casting are hobbed, and a pilot diameter is milled to insure concentricity of the threads and pilot when assembled with the barrel. In both of these operations the cylinder head is held in position on the machine with a swinging arm clamp, a pressure piece being employed which has slots to clear the fins so that pressure is transmitted to the main body of the casting when clamping the piece. This avoids distortion or breakage.

One of the most interesting operations in the cylinder production line is the assembly of the cylinder head to the barrel. Here, the cast aluminum heads are heated to about 600 F. in an electric furnace, then the head is placed upside down in a bench fixture, valve seats and guides (previously chilled in alcohol and dry ice) are inserted in the heated head and the barrel is threaded into the head casting, as shown in Fig. 18. This operation must be performed quickly and carefully else the head will contract around the cylinder barrel before it is properly seated. When the barrel is locked in position, the assembly is removed from the bench fixture, turned upside down and mounted on a floor stand with clamps, so that various bushings can be fitted into the head while it is still hot. Upon completion of this operation, the assembled cylinder unit is placed on a lift-truck platform to cool.

Upon completion of all machine and bench opera-

tions on the assembled cylinders, they are delivered either to a metal spray room or to a conveyorized cleaning and painting line for finishing prior to the last operations on the cylinder bore itself. Cylinder assemblies which are to be painted first go through a conveyor-type Mahon cleaning and bonderizing unit, as shown in Fig. 19. In this operation, cylinder assemblies are carried through the following sequence of operations: (1) clean in a Detrex vapor-spray-vapor degreaser; (2) bonderize; (3) wash in cold water; (4) dip in a chromic acid neutralizing bath; (5) pass through a gas-fired dryer; and (6) unload to a work bench where the port and rocker box openings are covered with precut adhesive paper masks, and the sparkplug and other small holes are filled with soft wood plugs so as to protect the interior of the assembly during the painting operation which follows.

Then the cylinders are hung head down on a conveyor line, as shown in Fig. 20, and are passed to a tank of black or zinc chromate priming paint, depending on specifications, where they are dipped by hand and laid on a tilted bench to drain. After a few minutes, the cylinders again are hung on the conveyor line and are passed between power-driven rolls which spin the cylinders at 250 r.p.m. for about 20 sec. to whirl off excess paint. The masks are then removed and the cylinders conveyed through an oven for baking at a temperature of 375 to 400 F. for 2½ hr. After baking, the conveyor carries the cylinders through a cooling chamber and then back to the position shown in Fig. 20 where new masks are applied and the cylinders are hung on a second conveyor line. Then they go through a similar cycle for a coating of finishing black enamel. For most of the cylinders, a second finish coat of black enamel is applied on a third conveyor line arranged in the same manner as the other two lines.

Some cylinder barrel and head assemblies are metallized with a spray gun, instead of being painted, in order to provide better resistance to salt water corrosion. Such assemblies first are shotblasted with fine steel grit in a special Wheelabrator unit in which the assembly is mounted on an adjustable-position rotating fixture that can be controlled from outside the cabinet. In order that all fin surfaces and the irregular contours of the head and barrel can be cleaned, the fixture is rotated and moved about continuously in the blast area. About 15 min. is required to thoroughly clean an assembly by this method. Upon completion of the shotblasting operation, the operator, using white cotton gloves to prevent oil or perspiration from forming a film on the cleaned surfaces, transfers the assembly to an adjustable stand in an adjacent spray booth. Here a second operator uses a Metco metal spray gun to thoroughly cover every exterior surface of the assembly

Fig. 18—Asbestos gloves and aprons are worn when handling the hot cylinder heads at the work bench where they are assembled with the steel cylinders. Operations in this group must be performed quickly, before the cylinder head cools

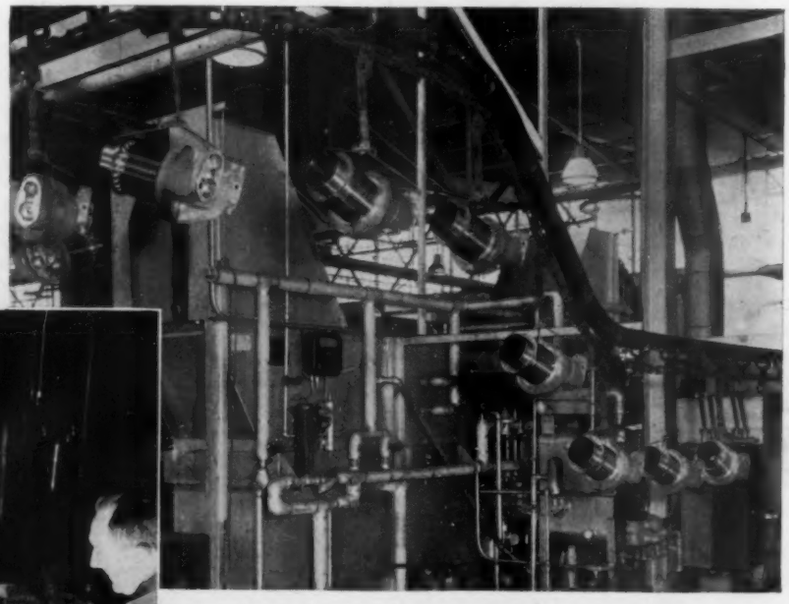


Fig. 19—Completed cylinder assemblies which are to be painted first go through a conveyorized cleaning and bonderizing unit at one end of the production line. Cylinders are supported by hangers carried on an overhead conveyor line

with pure aluminum. The table on the stand can be rotated by hand or power. First, the operator holds the gun in his hand to thoroughly coat the irregular surfaces of the cylinder head, then he mounts the gun in a holding fixture, and the stand is rotated by power and raised or lowered past the gun so that the fin surfaces and flange of the cylinder barrel can be coated evenly. As shown in Fig. 21, the operator in this spray booth is required to use a respirator throughout the spraying operation.

Final operations on the cylinder assemblies include an internal grinding operation, a finish honing operation, and a magnetic inspection. Both Bryant No. 24–26 and Heald No. 78 internal grinders are used to finish grind the cylinder bore. In Fig. 22 the operator is shown positioning a cast aluminum steadyrest with steel rings on the exhaust manifold pad of a cylinder to be ground. The assembly already has been centered and clamped in an adapter ring which locates against the flange and skirt of the barrel. The adapter ring and the steel ring on the steadyrest section serve to center the assembly in the pot chuck on the Bryant grinder. Two sets of rings and steadyrests are provided at each machine, so that the operator can set up one cylinder while another is being ground. As an extremely smooth finish is desired, this internal grinding operation requires approximately 30 minutes.

Fig. 21—Some cylinder assemblies are not painted, but are sprayed with a coating of pure aluminum to give increased protection against salt water corrosion. The operator must be careful that every part of the surface is adequately covered

Fig. 22—The bore of each cylinder is finish ground within 0.001 in. of the nominal diameter before honing. In this Bryant grinder, the assembly is located in a large pot chuck with centering rings

Fig. 20—A saving of more than 35 percent in paint costs has been realized by perfection of a dipping process for painting cylinder assemblies. In this set-up there are four lines of overhead conveyors

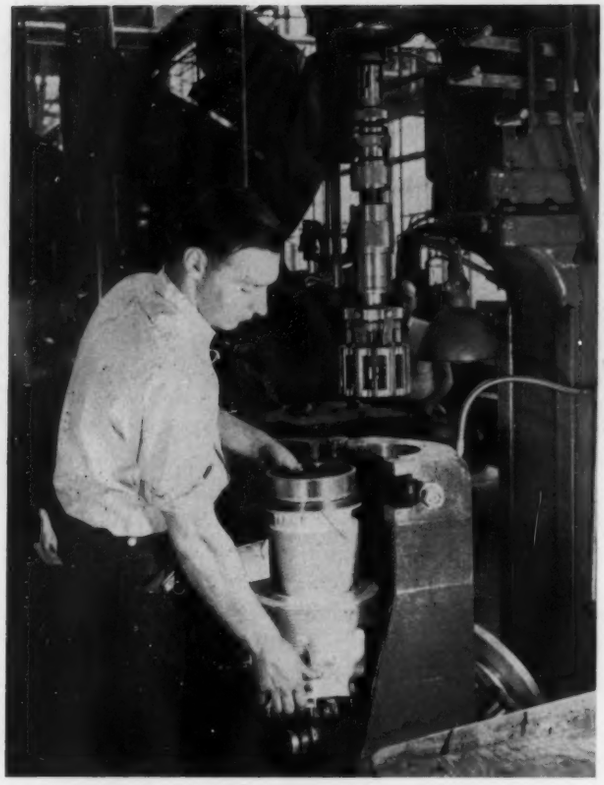
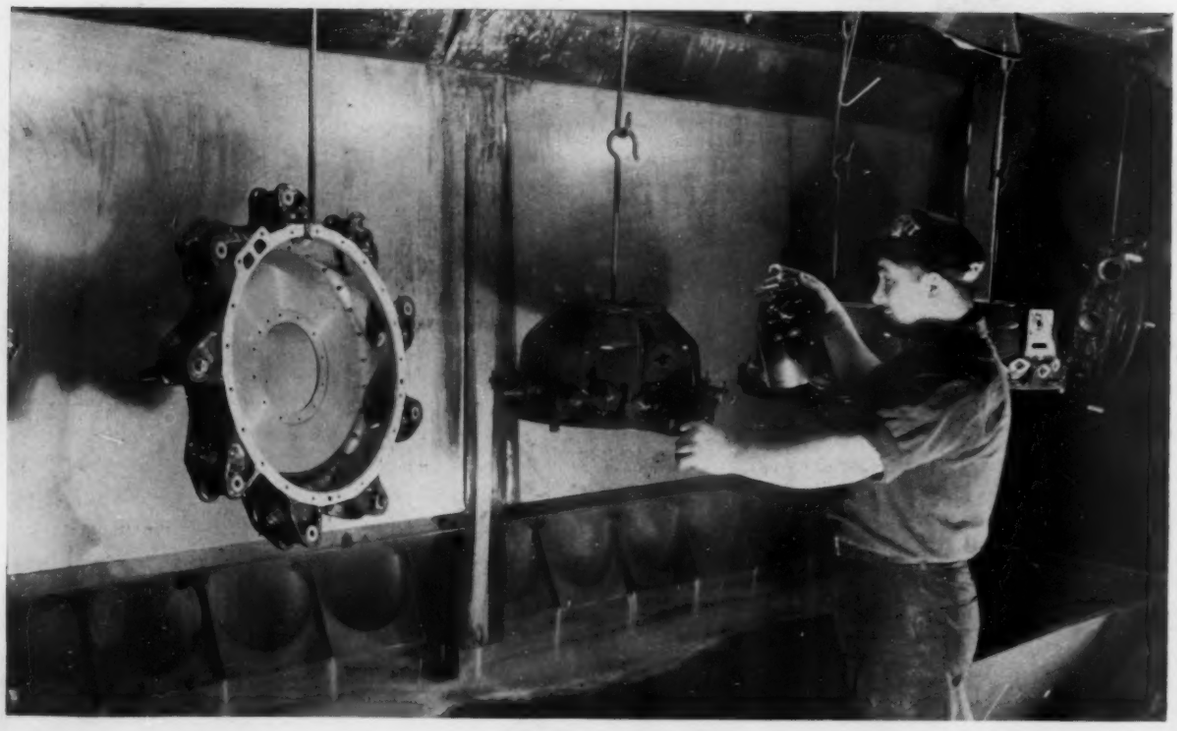


Fig. 24—Each cylinder barrel bore is carefully honed to a fine finish, and to accurate size, in single-spindle vertical machines. A heavy fixture supports the work during this operation

Fig. 23—Two recently developed Heald No. 78 internal centerless grinders also are used for finishing the bore of engine cylinders prior to honing. In this machine the assemblies are located in pot fixtures before being transferred to the grinding position

Fig. 25—A special magnetic inspection machine has been developed for checking assembled cylinders at the end of the production line

Fig. 26—Painters in Wright's finishing department no longer need wear protective respirators. At each of the painting stations an exhaust fan carries the excess spray toward a curtain of water at the rear of the booth



In Fig. 23 is shown the Heald No. 78 centerless internal grinder also used for finishing the bore of cylinder barrels. Here, the cylinder assembly is inserted in a pot having hardened and ground rings at each end, as shown in the center of the illustration. Then, the assembly is raised by an hydraulic cylinder and turned on its side so that it can be rolled on tracks to a checking position at the left. The dial indicator gage shown clamped in a checking arm at this position is used to make certain that the cylinder is centered within 0.001 in. in the pot, the pot being rotated on four rollers built into the machine table. When a cylinder has been ground, it is rolled out of the machine on tracks and lowered to the original position, then a track section is dropped into position and the next cylinder is rolled from the checking position across the tracks into the machine for grinding. Then the ground cylinder is removed from its pot and another inserted. Two chuck fixtures are provided for each machine, so that the operator can load and check one cylinder while another is being ground.

After the bore of the cylinder barrel has been finish ground in one of the two set-ups just described, the cylinder assemblies are delivered to a line of No. 249 Barnesdril hydraulic single-spindle honers equipped with Micromatic hones as shown in Fig. 24. For straight-bore cylinders, these honing heads have eight 500-grit stones, while cylinders having a choked bore are honed with special heads having six positions. In three alternate positions are fitted cork-backed fiber wipers, and in the three other positions corp sticks impregnated with diamond dust are employed. It will be noted that a steel ring is fitted around the skirt of the cylinder to support the thin wall at this position, and so prevent the pressure of the honing head from distorting the cylinder wall. Spindle speed when honing straight bores is 105 r.p.m., for choked bores the speed is increased to 418 r.p.m. The spindle is reciprocated at a speed of approximately 20 to 25 strokes per minute. The cylinder assembly is supported in a fixture which accurately aligns it with the axis of the machine spindle. Throughout the honing operation the work is flooded with a coolant made up of one part of a commercial honing compound and 15 parts kerosene.

Throughout the various machining departments, steel parts are checked thoroughly by magnetic inspection equipment to insure against delivering any imperfect parts to the assembly department. The high stresses involved in aircraft engines, together with the need for perfect operation throughout the life of the engine, necessitates throwing out any part having an internal defect. Because of the shape of some of the parts, a number of special magnetic inspection machines have been developed. One of these is the Magnaflux machine shown in Fig. 25. This unit, which incorporates a tank of oil containing iron dust is used for the final inspection of cylinder bores. The oil in the tank is circulated continuously by a pump in the base of the machine, and the cylinder is inserted open-end down into the tank. After a few minutes, it is removed and placed on a bench to drain, then carefully inspected as shown. The tank in this machine is surrounded by a coil which supplies the magnetic flux. When the cylinder has been approved, oil is wiped from the skirt and the cylinder is stamped with an inspector's mark. The assembly then is demagnetized in a unit at the other end of the inspection bench, and delivered to final inspection.

The application of the conveyor system of line-production to painting operations in the manufacture of Wright aircraft engines has eliminated much time-consuming handling. Painters now remain at their stations, as in Fig. 26, while the parts pass in front of them. In the painting of large crankcases, a 100 percent increase in production has been achieved. Priming and finishing coats are applied at four stations, three of which are included in the regular production line. The fourth station is reserved for parts requiring special painting. Normally, crankcase parts are sprayed with one prime coat of zinc chromate and two finishing coats of gray enamel. After each successive coat, the parts are carried by the conveyor line through ovens for baking. Except to rotate or steady a part while the spray gun is being used, crankcases and other components are not touched from the time they are attached to the conveyor until removed, ready for delivery to the final inspection department.

Crankshaft Assemblies Carefully Balanced

There are more than 30 parts in a crankshaft for a double-row Cyclone-14 engine. Four of these parts are made from bronze castings, the balance from steel forgings. All are machined all over, and are carefully polished to eliminate scratches that might lead to fatigue failure while the engine is in operation. Threads are milled, then ground, and all splines are hobbed and ground.

In Fig. 27 is shown a spline grinding operation on the front end section for a crankshaft being performed in a special machine built by the Gear Grinding Machine Company. This machine is placed in the production line adjacent to the Gould & Eberhardt hobber which cuts the splines. The splines first are rough ground, then finished, the wheel being dressed between the roughing and the finishing passes. The dresser has three diamonds and dresses the flanks and radius of the wheel. The 4-in. wheel is operated at 4,200 r.p.m. and is used until it is dressed down to $3\frac{1}{2}$ in. diameter. The rough-grinding operation re-

moves 0.010 to 0.012 in. and leaves approximately 0.002 in. for the finishing passes. The chordal tolerance on the finished splines is 0.0006 in. It is interesting to note that the internal spline in the mating part also is ground to the same close tolerances.

Before assembly to form the finished crankshaft, the mating surfaces of each section are carefully ground and polished for a perfect fit. After grinding, the center sections are polished with 150, 240 and 340 grit emery cloth held in a special chuck on the spindle of a Cincinnati-Bickford radial drill. Both sides of the center section are polished in this operation, and the surfaces must be parallel and perpendicular to the axis within 0.0005 in.

The surface of the front section which mates with the center section of the crankshaft is polished in the operation shown in Fig. 28. Here a special Foster superfinishing head is mounted on the spindle arm of a Bryant No. 24-L-36 internal grinder. The front section is mounted and centered in a pot chuck on the spindle of the machine, and is rotated at about 300 r.p.m. for roughing and 200 r.p.m. for finishing. Depending upon the condition of the ground surface when delivered to this machine, 120, 150, 240 and 320 grit emery cloth is used for the rough and semi-finish polishing, while 400 grit emery cloth is used for the final polishing operation. Three grades of cloth usually are sufficient to bring the surface to the desired condition.

A similar set-up on a Lehmann 36-in. Hydratrol engine lathe is used for polishing the corresponding surface on the rear sections of these crankshafts. Speeds and grits used are the same as for the set-up on the Bryant grinder. After completion of the polishing operation, the surfaces are covered with adhesive masking paper to keep off dust and dirt until the various sections can be assembled into a completed crankshaft.

First operation on a crankshaft assembly is the grinding of the crankpins in a Norton grinder, as shown in Fig. 29. Here, the center section is supported in a special steadyrest, and the front or rear section is supported on a special driving head. A 3½-in. wide, 42-in. diameter wheel is used, and the diameter of each pin must be ground within 0.0002 in. of the correct diameter. After the crankpin on one end of the shaft has been ground, the shaft is reversed in the pot chuck and the other crankpin is finished.

Three Gisholt Type 11 Dynetric balancers now take care of the dynamic balancing of crankshafts for all engines produced by the Paterson organization. During the balancing operation, shown in Fig. 30, very accurate "bob" weights are fitted around the crankpin bearings to compensate for the weight of the rods and pistons later to be assembled to the crankshaft. Once the operator has determined the amount and location of unbalance, a conversion table tells him the size and depth of drill to use in drilling the counterweight to bring the shaft assembly into rough balance. He then removes the counterweights from the assembly and sets them up in a jig at a Cincinnati-Bickford radial drill nearby. After drilling, the counterweights are reassembled on the crankshaft, and the assembly again is checked in the balancing machine. Final balance is obtained by drilling the counterweights with a Black & Decker drill mounted in a sliding arm support at the balancing machine.

Static balanced shaft assemblies checked in these machines have run as much as 85 oz. in. out of balance. Specifications require that the shaft assemblies be brought within 0.075 oz. in. at the crankpin radius when tested in a dynamic balancing machine. An inspector checks each shaft before it is removed from the machine. Approximately 1½ hr. is required to balance two-throw crankshafts such as are used in the double-row Cyclone engine.

Following the balancing operation on crankshafts, all of the bearing surfaces are polished in a Norton crankshaft bearing polisher. Here the seven bearings are polished in a 3-min. cycle, No. 320 grit abrasive paper being used. The shaft is rotated at about 15 r.p.m., and is oscillated about ⅛ in. When polished, the bearing surfaces are wrapped with wax paper and adhesive paper, then the crankshafts are packed in boxes for delivery to finished stores.

Connecting Rods Machined All Over

Two separate production groups handle the manufacture of master and articulated connecting rods for all engines produced in the Paterson plants. Because of the difference in quantities required, the group making articulated rods is the larger. Both types of rods are made from steel forgings, and are machined, ground and polished all over, so that there will be no scratches or machining marks on the finished product.

Rough machined articulated rods go to a No. 300 Hanchet vertical-spindle surface grinder where the rods are loaded in groups of seven on two arbors, and two arbor loads are set on the table for grinding the flat surfaces between the bearing bosses, first on one side and then on the other. The coolant used for this and other grinding operations on master and articulated connecting rods is a compound of one part soluble oil with 50 parts water. Following the first grinding operation, the rods are left on the two arbors, and are transferred to an adjacent Mattison surface grinder, shown in Fig. 31, having a special fixture on the work table for grinding the radius at one end of the rod. Again, two groups of seven rods are set up in the fixture. A form wheel is used, and the rods are indexed in three positions for rough grinding, then the fixture

Fig. 27—The involute splines on the front end section of a crankshaft for the Cyclone-14 engine first are hobbed, then form ground in a rough and finish grinding operation. The wheel dresser used in this operation has three diamonds

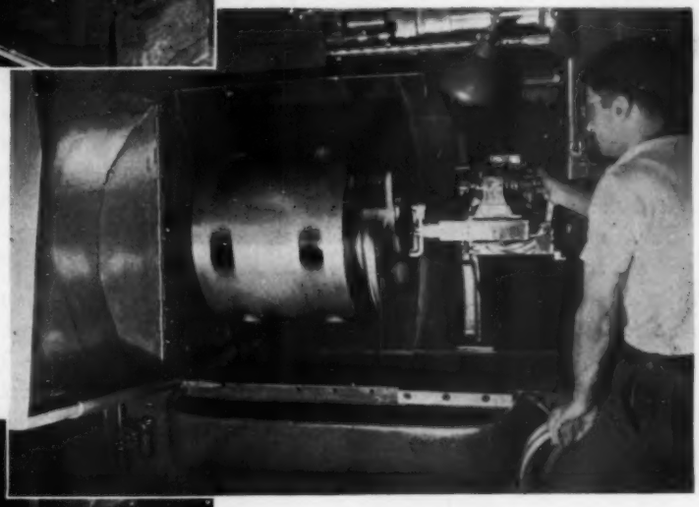


Fig. 28—With a superfinishing head mounted in place of the usual grinding spindle, this Bryant No. 24-L-36 internal grinder is used for a polishing operation on the front section of the crankshaft

Fig. 29—Both crankpins are ground to within 0.0002 in. in this Norton grinder located in the crankshaft department

Fig. 30—Two-throw crankshaft for the 14-cylinder Cyclone engine must be brought into dynamic balance within 0.075 oz. in. at the crankpin radius before it can be accepted for assembly in an engine

Fig. 31—In this grinding operation on one end of a group of twelve articulated connecting rods, the fixture first indexes the rods to three positions for rough grinding, then oscillates the rods back and forth while the table reciprocates for the finish grinding cycle

is set to oscillate by power while the table is reciprocated back and forth to finish grind the radius at one end. On this machine the 18-in. diameter wheel rotates at 1,160 r.p.m. and removes 0.050 in. when roughing, and approximately 0.010 in. when finishing. A diamond dresser is mounted at one end of the fixture for dressing the wheel between the roughing and finishing passes. Rods finish ground on one end are taken to a second similar machine where the radius on the other end is ground in the same way. Next, the rods are removed from the arbors and delivered to a LeMaire special grinder where the channels on each side of the rod are finish ground.

Finish machined and ground articulated connecting rods are stamped with part numbers in a Hannifin hydraulic press set to stamp impressions having a maximum depth of 0.003 in. Stamping dies having rounded edges so that no sharp corners will be produced which later might develop fatigue cracks when the rod is used in an engine. A similar arrangement is used for marking part numbers on the master connecting rods.

In Fig. 32 is shown one of the nine special Sundstrand vertical-spindle heavy-duty milling machines used for rough and finished milling operations on master connecting rods. The various operations are divided among these nine machines, and each has a special table fixture fitted to its individual operation. Heavy-duty, high-speed steel milling cutters are used.

Master connecting rods which have been bored and milled next are delivered to a multiple-spindle Natco drilling and reaming machine, as shown in Fig. 33, where the six knuckle pin holes are finished. For the sake of accuracy, the reamers used in this machine are piloted in bushings fitted into the base of the fixture. There are three groups of six spindles each mounted above a four-position table on this unit. At the first position, the operator loads and unloads the work, then indexes the fixture by hand. At the second position the six holes are rough drilled, then they are finish-drilled at the third position, and at the final position they are finish reamed to size.

Some Rod Bores are Plated

After internal grinding the crankpin bore and the knuckle pin bores in the master connecting rod, these bores are honed, hard-chromium plated, then finished to size in two Barnesdrill hydraulic vertical-spindle honing machines using Micromatic hones. The simple fixture used for the crankpin hole is shown in Fig. 34. Dummy knuckle pins are pressed into position before the master rod reaches this machine. This operation brings the hole within 0.0002 in. of the desired diameter. Pin holes at each end of the articulated connecting rods are finished by internal grinding.

Next, a steel-backed copper-lead bearing is pressed into the main bearing bore of the master rod and a bronze bushing is pressed into the piston pin hole. Similarly, bronze bushings are pressed into the knuckle

Fig. 32—Rough and finish milling operations on master connecting rods are divided among nine special Sundstrand heavy-duty millers. Each of these machines has a vertical spindle and a special table

Fig. 33—The six knuckle tin holes in the large end of each master connecting rod are drilled and reamed in this 18-spindle Natco machine equipped with a four-position fixture

pin and piston pin holes of articulated rods. In each case, the bronze bushings are spun over at each end to lock them into position, using a drill press set-up as shown in Fig. 35. The tool used in each case consists of the inner ring and roller assembly from a Timken tapered roller bearing fitted on a spindle held in the chuck of the drill press. A table locating fixture holds the connecting rod bushing central during the spinning operation. The operator first spins one side, then reverses the connecting rod on the fixture pin and spins the other end of the bushing.

After spinning each end of the bushings in the ends of connecting rods, these bushing ends are spot-faced in a sensitive drill press, using a high-speed steel cutter, and then they are burred by hand to remove the sharp edges. Following this, each bearing bushing is finished by diamond boring in two-spindle Coulter boring machines. For the articulated rod, the diamond tools rotate at about 2,100 r.p.m., and are fed through the bore by cam feed. Each tool removes about 0.012 in. on the diameter in one cut, using a cutting oil made up of one part mineral seal oil and one part light spindle oil. These holes are finished to a surface accuracy of 10 microinches.

After diamond boring the bushings at each end of the connecting rod, each rod is carefully polished to remove machining marks and scratches, then finished master and articulated connecting rods go to separate inspection rooms for checking. Each rod is inspected for accuracy, and is put through a magnetic inspection as a final check against internal flaws. Then each rod is weighed carefully in a set-up like that shown in Fig. 36 so that its balance may be kept within specified limits. In these weighing set-ups, two Exact-Weight scales are mounted on a platform above the inspection bench, and the connecting rod is suspended by special hangers from the weighing platforms.

Gears Made to Close Limits

Particular attention is paid to the production of gears and cams for Wright aircraft engines. Necessarily of minimum section, in order that the engine may have the least possible weight, the gears in aircraft engines probably are worked at higher tooth loads than are gears in any other mechanism. No wonder, then, that the gear production departments in the Wright plants continually are experimenting with new or improved gear production methods. There is a constant endeavor to improve tools and methods to maintain or improve quality of the gears produced.

For most of the Wright aircraft engine gears, the only deviation from the standard 20-deg. pressure angle involute tooth is the addition of a full fillet radius at the root of the tooth. This fillet removes the possibility of any sharp angles at the weakest section of the tooth, and so reduces materially the possibility of tooth breakage. In principle, gears are designed to meet certain operating conditions, rather than to fit

Fig. 34—Honing operations bring the crankpin bearing hole and the knuckle pin holes of the master connecting rod within 0.0002 in. of the desired diameters. Usually these holes are chromium plated

Fig. 35—Each end of the bronze bushings pressed into place in the ends of connecting rods are spun over to lock the bushings in place. The spinning roller usually is rotated at 1,100 r.p.m.

existing tools. Tools and cutters then are made or purchased to suit the required gear.

All of the gears in Wright aircraft engines are made from forgings which are normalized before machining. About three-fourths of them are made from SAE 3112 carburizing steel, the balance from Nitralloy steel. Gear and cam ring forgings are machined on turret lathes using, in most cases, carbide-tipped tools. A battery of nine Bullard Multi-Au-Matics recently installed in this department made possible major savings in production time. Prior to the acceleration in production made necessary by the defense program, production requirements did not justify such high-production equipment. Now, such machines are essential.

While a number of the straight-tooth spur gears and practically all helical gears and splines are hobbed in standard gear hobbers, requirements for gear production have necessitated the installation of more than 100 Fellows gear shapers like the Type 6-A unit shown in Fig. 37. This illustration shows the finishing cut on the sun gear for the reduction gear train of a Cyclone-14 engine. This is a 36-tooth, 5.4 diametral pitch, 20-deg. pressure angle gear measuring approximately $6\frac{3}{4}$ in. outside diameter with a 1-in. face. The teeth are roughed in one machine, then finished in a second machine nearby. In this department, one operator takes care of three such machines, being allowed 22 min. for the roughing operation on the sun gear, and 32 min. for the finishing operation. During both operations the work is flooded with a cutting oil compounded from one part of heavy base oil and three parts paraffin oil.

After the teeth have been cut, all gears are hardened, and then about 90 percent of them are ground on the tooth form. Carburized gears usually are heat-treated to provide a case hardness of about 60 Rockwell C, with a 0.025 to 0.035 in. depth of case. Most spur gear teeth are finished by grinding in Pratt & Whitney single-wheel or two-wheel gear grinders, as shown in Fig. 38, or in Lees-Bradner two-wheel gear grinders. Several slower Maag gear grinders are employed in this department for making master gears and for experimental work. The coolant used when grinding gear teeth is a special thread-grinding oil having an A.P.I. gravity of 29.0 at 60 F., and a viscosity of 88 sec. at 100 F. Most spur gears are lapped in standard gear lapping machines after grinding, the operation being continued just long enough to remove grinding fuzz.

Burrs are removed and gear tooth edges are rounded with hand grinders just before the finished gears are delivered to final inspection. In most cases this operation is performed with Madison-Kipp high-speed pneumatic grinders as shown in Fig. 39. The bench fixture

Fig. 36—After going through a critical inspection to determine that its dimensions are accurate, each rod is weighed in a two-scale arrangement. Each end of master connecting rods must be within 0.03 lb. of a predetermined standard

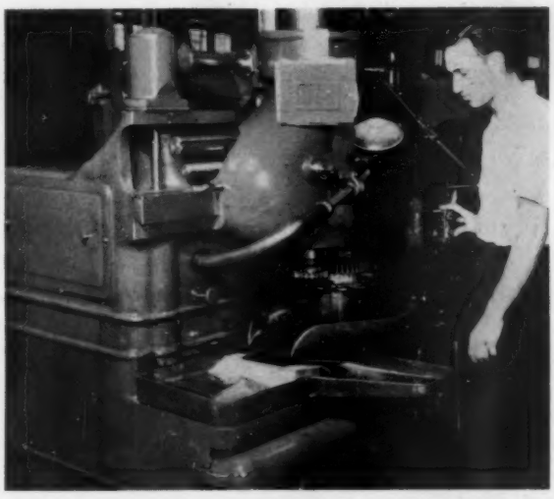


Fig. 37—A large battery of gear shapers and hobbers are kept busy cutting the gears and splines needed for Wright aircraft engines

Fig. 38—Most gear teeth are finished by grinding in single- or two-wheel gear grinders. Standard backlash allowance is 0.002 to 0.006 in.

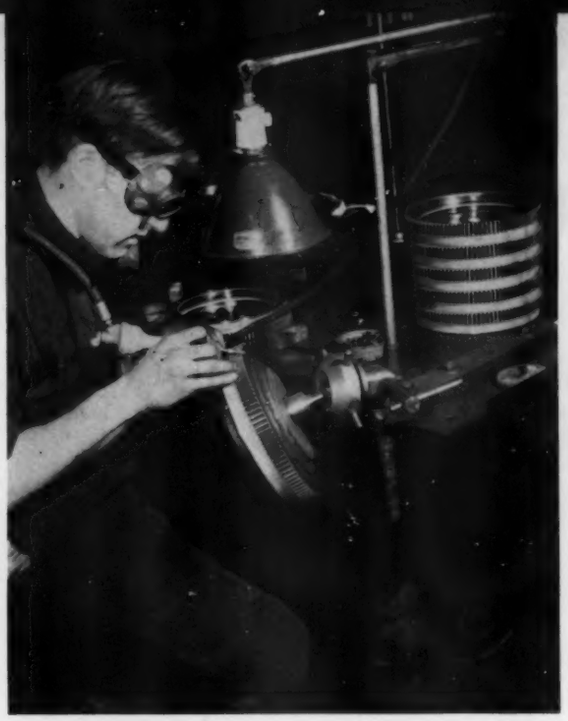


Fig. 39—Special bench fixtures are used to hold the various gears for hand finishing operations. This workman is rounding the ends of the teeth on a large spur gear for a Cyclone-14 engine

Fig. 40—Individually-driven cutters mill the intake and exhaust radial cams in this Van Norman machine. A roughing and a finishing cut are taken

Fig. 41—Landis cam grinders are used for finishing the intake and exhaust cams one at a time. These two cams are side by side on the same forging

seen in this illustration is of particular interest, since it permits positioning the gear at almost any angle to suit the convenience of the operator. It has a ball joint which quickly can be locked in position with a clamping ring. Certain of the gears go to a glass-inclosed finishing room where the bores are honed and the hubs on some are superfinished. Surfaces produced by honing or superfinishing are held to a fineness of less than 5 microinches. All gears go through a 100 percent inspection, tooth spacing and involutes are held within 0.0002 in. (about the accuracy of master gears), and in most cases it is required that they run within 0.0005-in. concentric with their bearing.

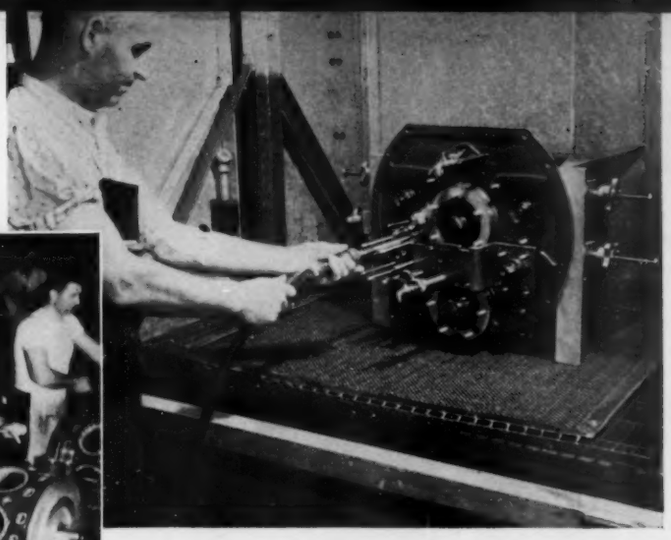
In order to speed production of radial intake and exhaust cam rings, the gear department has installed several Van Norman two-spindle radial cam millers for rough and finish milling intake and exhaust cams. As shown in Fig. 40, the two cutter heads on this machine are controlled by separate master radial cams on the work spindle. Each cutter mills a separate cam on the forged single-piece cam ring, the cutter heads being held against the master cams by hydraulic pressure.

When milling these radial cams, a production lot first is rough milled, then the machine is set up for finish milling, and the lot is run through again. The pieces, which have been finish machined except for the cam, are loaded one at a time on the work spindle, and the roughing cut leaves about 0.050 in. for finish milling and grinding. Each cutter is driven by a 3-hp. motor at approximately 100 r.p.m. The high-speed steel cutters are $3\frac{1}{4}$ to $3\frac{1}{2}$ in. in diameter, and are $\frac{5}{8}$ in. wide. After milling the pieces are burred by hand, then are carburized and hardened.

When the cam rings have been hardened, they are delivered to a Landis 18-in. radial cam grinder like that shown in Fig. 41, where the intake and exhaust cams are finish ground and polished, one cam being finished at a time. Usual practice is to grind a lot of cam rings, then remount the rings for polishing later. One cam is ground at a time, two settings of the wheel head being necessary for each set-up in the machine. Norton No. 3850-J5-BE wheels are used for the grinding operation and Macklin No. 180-1-503 wheels are used for polishing. Approximately 0.025 in. is removed during the finish-grinding operation, and a dimensional tolerance of ± 0.010 in. is allowed on the finished cam surface. These cam rings are more than 14 in. in diameter, and 61 min. are allowed for the finish grinding operations, with 21 min. allowed for the polishing operations.

A number of interesting operations are involved in the manufacture of the reduction gear carrier ring for the Cyclone-14 engine. After several turret lathe operations, the forged steel ring is delivered to a Barnesdril

Fig. 42—Often complicated fixtures are necessary when flushing wax out of oil lines in some of the castings and sub-assemblies



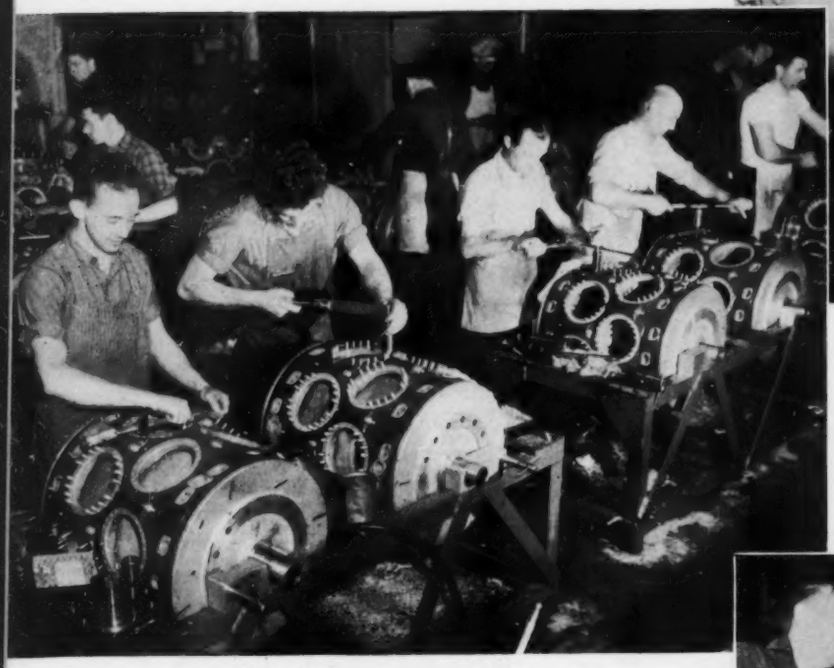


Fig. 43—Cylinder studs in aluminum crankcases for 14-cylinder Cyclone engines are tightened to a predetermined height and tension with torque wrenches

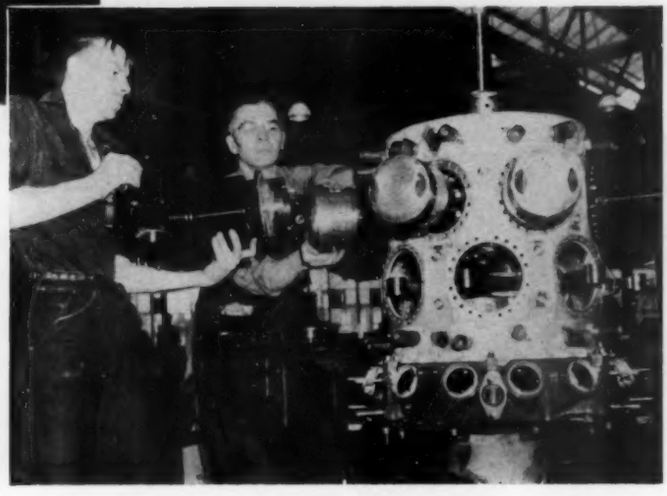


Fig. 44—By sub-dividing engine assembly operations, Wright now has a progressive assembly line that can deliver a "green" engine to the test cells every 24 minutes. Each group performs only certain specified operations

drill press for the first hollow milling operation on the 20 trunnions. An indexing fixture with a large guide bushing is used to locate the hollow mill. In this operation the diameter of each of the trunnions is held to 0.760–0.766 in. with a 1.240–1.265 in. boss 0.028 in. high at the bottom of each trunnion. Roughing is done at 47 r.p.m. and finishing at 93 r.p.m., both being performed with high-speed steel cutters. Following this operation the carrier ring is copper plated, and the trunnions then are hollow milled a second time in a two-head No. 47-A Heald Bore-Matic unit using carbide-tipped cutters. Two trunnions are machined at each feed stroke in this machine. This leaves the trunnion surfaces and the boss surfaces clean for carburizing and hardening in the next operation.

After the trunnion surfaces have been hardened, the carrier rings are delivered to a group of internal grinders where the trunnion and boss surfaces are rough and finish hollow ground. Both Heald No. 172 and Bryant No. 16–38 internal grinders are used. Each of these machines has a special counterbalanced fixture on the work spindle and is arranged to successively bring each trunnion into the center of rotation for grinding. When rough grinding, a Norton No. 3880-LGB-E wheel is used, and the diameter of the trunnion is held within 0.002 in., the position of the boss being held within 0.002 in. and the radius held to 0.100 in. The rough grinding operation requires approximately $2\frac{1}{2}$ hr.

Using the same wheel as for roughing, the finish grind operation holds the diameter of the trunnion within 0.0003 in., and removes approximately 0.007 in. on the diameter. About 0.003 in. is removed from the face of the boss and the radius blended between the boss face and the trunnion surface is held to 0.100 in. Spacing of the trunnions cannot vary more than 0.0005 in. and accumulated spacing errors are held to 0.001 or less to insure even loading of the 20 gears.

Several Walker-Turner bench drills, each with a special table and polishing head, are used for final

polishing trunnions and bosses on the reduction gear carrier rings. This operation brings the trunnion diameters to 0.7170–0.7180 in., using 240-grit emery cloth for rough polishing, and 320-grit emery cloth for final polishing. When polishing the bosses, 150-grit emery cloth is used. In the group set up for this operation, one machine is used to polish bosses, another for rough polishing the trunnion, and a third for finish polishing the trunnion. Before and after each operation, the part is dipped in a slushing compound made up of equal parts of varsol and sulphonated lanolin to clean the surfaces and leave a corrosion preventive film on the surface.

Engines Now Assembled Progressively

All operations in the assembly department have been restudied and set up so that progressive assembly methods can be used. Each group now need be proficient only in its particular portion of the assembly. This allows for a shorter training period and eliminates many of the errors possible when one small crew of three or four men does all of the operations necessary to assemble an engine. With the progressive set-up, the operations are less than 24 min. each, and each operation has been clearly defined for the assembly groups.

Sub-assemblies are completed at work benches in fenced-in sections of the assembly department, and these are delivered as needed to the progressive assembly lines. Often parts delivered to the sub-assembly groups must be processed before they can be assembled. For instance, on parts which have oil supply lines, these lines are filled with a special wax prior to final machining operations. This wax is compounded so that it will not break out when machined, and serves to prevent chips entering the oil lines while finishing cuts are being taken. This wax, of course, must be removed from the oil lines before the part is assembled into a completed engine.

For this purpose, a special dewaxing set-up has been installed in one part of the assembly department. Here, the parts are placed in special holding fixtures, as shown in Fig. 42, which plug certain openings in the various castings and the fixture is lowered into a tank of boiling water for a soaking period. Then the rack is raised above the water line and moved over an oil tank, and hot oil at 400 F. is forced through each oil line. This flushes out any wax remaining after the long soak in the hot water tank. In order to insure that each line is clear, petcocks are installed at one end of each line, and oil is forced through from the other end. Where a number of lines are fed from a central supply port, only the petcock on the end of the line being tested is opened. By this means, each line can be tested individually for free flow of hot oil.

One of the largest groups in the sub-assembly section is that fitting studs to cylinder pads on aluminum crankcases. Sixteen tapered studs must be set to an equal height at the same tension in each of the 14 cylinder positions on an aluminum crankcase for the Cyclone-14 engine. The studs first are run in as far as possible by hand, then tightened with a Sturtevant torque wrench as shown in Fig. 43. To increase the efficiency of this operation, each cylinder assembly is mounted between end plates on a tube extending between angle-iron supports. In one of the end plates is a circle of 14 holes spaced so as to bring one of the 14 cylinder pads into the top position when a pin on the rack is entered into a hole in the end plate.

With sub-assemblies feeding into the main assembly lines, the first step is to assemble the crankshaft and connecting rods in the crankcase itself. For this operation the crankcase is dismantled, and the crankshaft and case assembled together section by section in a special fixture at one end of each assembly bench. Crankcase and crankshaft assemblies delivered to the progressive assembly line are mounted on universally adjustable dollies which can be turned to hold the engine in practically any position. These units are so balanced that one man can turn a complete engine over without difficulty. The progressive assembly lines have 22 work stations where assemblers skilled in a particular group of operations perform their work and then pass the engine on its mount along to another group for further operations.

Pistons are fitted to one row of connecting rods at one of the stations on the progressive assembly line, then the cylinders for this row are fitted in place as shown in Fig. 44. The pistons come to the assembly position marked for a particular engine and crankcase position, and must be assembled in that order. At the next station, cylinders are fitted over the pistons and then the cylinder holddown nuts or screws are positioned and pulled tight with Sturtevant torque wrenches for even loading. At the next station, pistons for the other row of connecting rods are fitted and then cylinders are fitted over these pistons.

As the engine progresses down the assembly line other parts are added, see Fig. 45, until at the end of the line a completed "green" engine is ready for delivery to the test cells. These cells are capable of testing engines up to 3,000 hp. and are provided with special equipment to simulate varying flight conditions. Where formerly a couple of testers took an engine from the assembly floor to the test cell and there installed it on the stand, attached all accessories, and ran the test; the engine now is assembled on the mounting bracket used for testing, then one crew attaches the necessary accessories, and the testers have only to attach the mounting bracket to the test stand and attach controls and in-

strument wires before starting the specified tests.

After a 7-hr. run in the test cell, the "green" engine is returned to the assembly shop and completely torn down. The parts are laid out on special tables and each part is rigidly inspected for wear and scratches. If every part passes this test satisfactorily, the engine is reassembled in much the same manner as was the "green" engine, with all adjustments being checked carefully by an inspector. However, if any part is found to be worn or damaged, that part is replaced, the engine is reassembled, and it goes back to the test cell for a 7-hr. "penalty" run, then the engine comes back again for a tear-down test.

Cleanliness and quality of workmanship are of prime importance on both the "green" assembly line, and the final assembly line. Reassembled engines are returned to the test cells for a 3- to 4-hr. run of which the last one-half hour is on non-leaded gas to eliminate any danger of corrosion inside the engine if it should be stored for an extended period of time. When safely through this final test run, the engine is returned to the assembly department, so that it can be prepared for shipment. The complete engine goes through a special Detrex washing machine where it is sprayed with gasoline and dried with air jets. Then it is delivered to a final adjustment line where fittings and covers are added. When ready for shipment, each engine is slushed inside and out with a corrosion preventative compound, while the engine is rotated with a compressed air motor.

From the start of the assembly line to the shipping floor, each engine is accompanied by folder containing a complete packing list and the inspectors' report. Notations are added to this report by each inspector who goes over the engine from the time it starts down the "green" assembly line until it is shipped.

Fig. 45—Each engine is assembled on a mounting bracket which later is used to support the engine in the test cell. Assembly cradles are balanced so one man can swing an engine over easily for operations on the other end

Sprayed Coatings—I

Defects and Their Correction

Courtesy The DeVilbiss Company

SUCCESSFUL APPLICATION of sprayed coatings depends on handling technique and proper maintenance of spraying equipment. Below in tabular form are detailed various troubles in spray finishing, their causes and remedies. The diameter and length of hose has a marked effect on performance of the spray gun. Small diameter hose will "starve" the gun and cause insufficient atomization. Table below shows pressure drop for various sizes and lengths.

MECHANICAL DIFFICULTIES

Trouble	*Cause*
Fluid leakage	Loose nut — tighten but not enough to seize
A — From needle packing nut	Dry packing — lubricate
B — From front of gun	Needle not seating
	Worn tip — replace
	Dirt on tip — clean
	Broken needle spring — replace
	Packing nut too tight
Air leakage	Air valve not seating
	Dirt on valve or seat
	Worn valve or seat
	Broken spring
	Sticking valve stem
	Tight packing nut

Trouble	*Cause*
Jerky, fluttering spray	Air leakage into fluid line
	Pressure and Suction feed;
	Insufficient material in container
	Container tipped at acute angle
	Obstructed fluid passage
	Loose or cracked fluid tube in cup
	Loose fluid tip, or damaged tip seat
	Suction feed:
	Material too heavy for suction
	Clogged air vent in cup lid
	Loose, dirty or damaged coupling nut on cup lid
	Loose fluid needle packing nut
	Fluid tube too far down in cup, resting on bottom

TABLE OF DROP IN AIR PRESSURE

To be expected from various lengths of ¼-in. and 5/16-in. air hose when used with spray gun equipped with air cap consuming approximately 12 cu.ft. of air per min. at 60 lb. pressure

Size of Air Hose Inside Diameter	*Pressure Drop at Spray Gun — Lb.*					
	5-foot length	*10-foot length*	*15-foot length*	*20-foot length*	*25-foot length*	*50-foot length*
¼ Inch						
At 40 lb. pressure	6	8	9½	11	12¾	24
At 50 lb. pressure	7½	10	12	14	16	28
At 60 lb. pressure	9	12½	14½	16¾	19	31
At 70 lb. pressure	10¾	14½	17	19½	22½	34
At 80 lb. pressure	12¼	16½	19½	22½	25½	37
At 90 lb. pressure	14	18¾	22	25¼	29	39½
5/16 Inch						
At 40 lb. pressure	2¼	2¾	3¼	3½	4	8½
At 50 lb. pressure	3	3½	4	4½	5	10
At 60 lb. pressure	3¾	4½	5	5½	6	11½
At 70 lb. pressure	4½	5¼	6	6¾	7¼	13
At 80 lb. pressure	5½	6¼	7	8	8¾	14½
At 90 lb. pressure	6½	7½	8½	9½	10½	16

THESE and other implements of defense would be less than America's best were they not built with — *and* equipped with the enduring qualities of

NEW DEPARTURE

THE FORGED STEEL BEARING

AMERICAN MACHINIST REFERENCE BOOK SHEET

Sprayed Coatings—II

Defects and Their Correction

Courtesy The DeVilbiss Company

1. Heavy top pattern.
   (a) Horn holes partially plugged.
   (b) Obstruction on top of fluid tip.
   (c) Dirt on air cap seat or fluid tip seat.

2. Heavy bottom pattern.
   (a) Horn holes partially plugged.
   (b) Obstruction on bottom side of fluid tip.
   (c) Dirt on air cap seat or fluid tip seat.

3. Heavy right side pattern.
   (a) Right side of horn holes partially clogged.
   (b) Dirt on right side of Fluid Tip.
   (c) On twin jet cap, right jet clogged.

4. Heavy left side pattern.
   (a) Left side of horn holes partially clogged.
   (b) Dirt on left side of fluid tip.
   (c) On twin jet cap, left jet clogged.

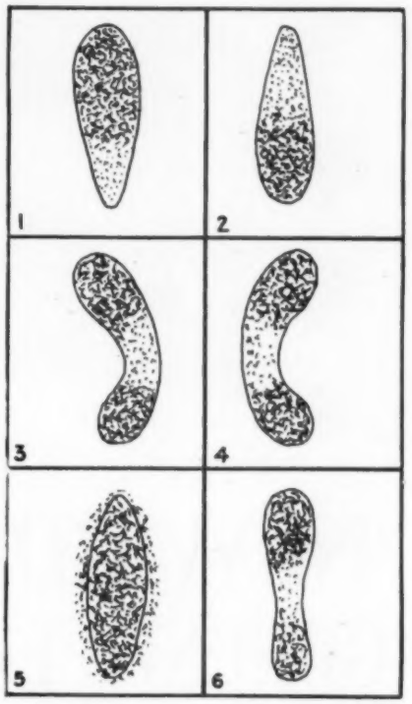
5. Heavy center pattern.
   (a) Too low a setting of spreader adjustment valve.
   (b) With twin jet cap, too low atomizing pressure or material of too great viscosity.
   (c) With pressure feed, too high fluid pressure for cap's normal capacity.
   (d) Too large nozzle for material used.

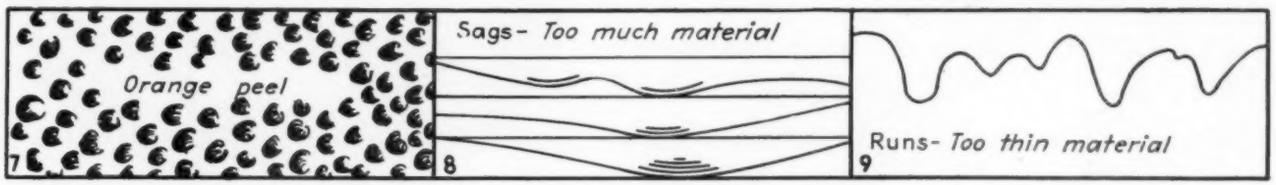
6. "Split spray" pattern. Air and fluid not properly balanced. Reduce width of spray pattern by means of spreader adjustment valve or increase fluid pressure. This latter adjustment increases speed and gun must be handled much faster.

For Numbers 1 to 4: Determine if obstruction is on air cap or fluid tip. Rotate cap one half turn and spray another pattern. If defect is inverted obstruction is on air cap, if not inverted it is on fluid tip.

Clean air cap. Check for fine burr on edge of fluid tip or for dried paint just inside opening.

For Numbers 5 and 6: If adjustments are out of balance, readjust atomizing pressure, fluid pressure and spray width adjustment until desired spray is obtained.





7. Orange Peel Finish. A common cause is improper thinner or too cheap a thinner. A thinner containing a high percent of low boiling or cheap solvents will cause "orange peel" regardless of how the material is applied.

   Other causes are:
   1. Insufficient atomization.
   2. Gun too far from surface.
   3. Gun too close to surface — air tends to ripple surface.
   4. Material not thoroughly dissolved or agitated.
   5. With synthetics and lacquers, drafts in finishing room.
   6. With synthetics, too low humidity.

8. Streaks in finish.
   1. Tipping Gun. One side of pattern hits surface from shorter distance causing more material to be applied at this point.
   2. Air cap or fluid tip may have dirt or burr on them causing heavy top or bottom pattern.
   3. "Split spray" causing more material to be applied at top and bottom of pattern. Increase fluid pressure or reduce width of spray by decreasing horn air.

9. Runs and sags in finish.
   1. Sags and runs result from applying too much material. Cut down fluid pressure or increase operating speed.
   2. Gun tilted at angle. More material is supplied where pattern is closest to surface.

10. Mist or fog.
    1. Over atomization due to:
       (a) Too high atomizing air pressure.
       (b) Wrong air cap for material used.
       (c) Wrong fluid tip for material used.
       (d) Fluid pressure too low (pressure feed).
    2. Improper use of Gun:
       (a) Incorrect stroking.
       (b) Gun held too far from surface.

Notes: 1. Heavy, coarse or fibrous materials require large nozzle sizes, to permit passage of the material and prevent clogging. (Plastic paints).

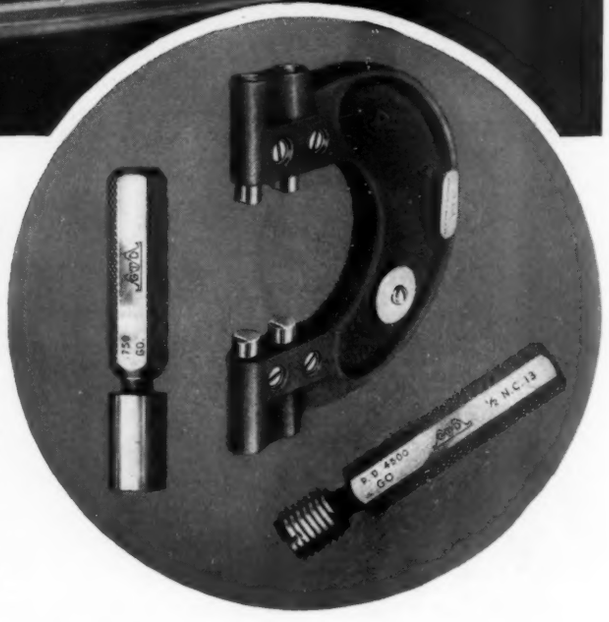
2. Viscous materials requiring high atomizing pressures are handled better through small nozzle sizes which assure more complete atomization. (Synthetic enamels).

3. Very thin materials that sag readily are applied at low atomizing pressures with small nozzle sizes to prevent excessive material application. (Stains).

4. Abrasive or corrosive materials must be handled with tips made of wear-resistant or non-corrosive metals. (Wood bleaches as used in furniture manufacture and metal cleaners require non-corrosive tips. Porcelain enamel requires abrasion-resistant tips).

5. The nozzle size sometimes recommended for suction feed will not be satisfactory for pressure feed.

NEW HOME for "GREENFIELD" Gages



MEMORIAL DAY at "*Greenfield*" was marked by the opening of this new modern air-conditioned plant, devoted entirely to the manufacture of Plain, Thread and Limit Snap Gages. It will more than double "*Greenfield's*" gage manufacturing capacity and symbolizes "*Greenfield's*" determination to cooperate in every way with the national defense program.

The most modern machinery and complete air conditioning will materially assist our hundreds of trained and experienced gage workers to maintain the closest possible control over manufacturing conditions. Even with the greatly enlarged output that the new building makes possible, individual quality and accuracy will be maintained and increased.

Increased research and testing facilities are an important part of the new equipment and will be used unceasingly for the benefit of our friends and customers.

GREENFIELD TAP & DIE CORPORATION
GREENFIELD, MASSACHUSETTS
DETROIT PLANT: 2102 West Fort St.
WAREHOUSES in New York, Chicago and Los Angeles
In Canada:
GREENFIELD TAP & DIE CORP. OF CANADA, LTD., GALT, ONT.

GTD GREENFIELD

TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

Uncle Sam Means What He Says

ALL OF US know what happened at North American Aviation. Arguments, pleas for cooperation and appeals to patriotism of the workers got nowhere. It wasn't until Uncle Sam marched in his soldiers that the strikers had the fact driven home that Washington means business these days.

Recalcitrant workers found themselves in the uncomfortable and embarrassing position of being unceremoniously thrown across Uncle Sam's knees and soundly whacked. How much better it would have been for organized labor, and for its standing in the eyes of the public, if it had done voluntarily what Uncle Sam made it do.

It is no exaggeration to say that industry is likely to find itself in as awkward a situation as organized labor if a considerable group of manufacturers continues to refuse to cooperate in or to be indifferent to their defense obligations, thus jeopardizing the position of all.

Defense officials have pleaded for months with big shops and little to forget about business as usual and dig in and really do an armament job for Uncle Sam. They have talked until they were blue in the face about utilizing all the country's machine-hours in an all-out effort to reconstruct our defenses quickly and to aid Britain.

Yet things haven't gone as they should, though industry has given a commendable performance. Some industrialists seem to have secured the same mistaken impression as organized labor that Washington is saying many bold things about defense plans with its tongue in its cheek and that when it talks about the urgency of its program, it is overly excited.

Call their attitude whatever you will—indifference, lack of understanding, selfishness, conviction that America is not in peril—the fact remains that the nation is committed to an all-out defense undertaking and intends to see it through.

Many, many manufacturers have to their credit a sterling performance on behalf of rearmament. But too many others are still holding back. They have idle machines in their plants, which may be used a few hours a day or a week, available for defense operations. Yet they are not lifting a finger to cooperate in putting these machines to work. And often the machines are of a critical nature.

To say that a way cannot be found to get these machines into operation round the clock is admitting mental laziness or incompetence of management. And we have heard so much about the peerless management of American industry that we cannot believe it is due to incompetence.

Those people who sit with critical idle machines in one corner of their shops and do nothing to get them busy on munitions production or to release them to contractors who badly need them are inviting trouble. They are inviting the government to move in and make them do what they refuse to do voluntarily. They also are unwittingly encouragaging defense officials to seize the unused equipment and put it to work elsewhere. At the same time they are doing an injustice to the thousands of patriotic manufacturers who have not stinted in their efforts to speed up the defense timetable.

If you have machines not kept busy all the time or machines in disuse, tell the Contract Service Section of OPM about them. Its address is the Social Security Building, Washington, D. C. They will see that idle machine hours are turned into productive machine hours.

Burnham Finney

GAGING BUSINESS

Concentration of non-defense production in a few plants being studied by OPM. Over $500,000,000 of machine tools should be delivered in a year to expedite new bomber production program

Concentration of non-defense production in a few plants in any single industry which can then operate at capacity, releasing badly-needed machine tools for defense work, is being studied by OPM. The same principle may be applied to defense industries, where the main objective would be to coordinate production to secure maximum output. It means looking upon entire industries as a unit of production, a scheme put into effect in England. It also emphasizes the gravity of the problem of putting to work at once all the idle or partially idle machine tools in this country on defense production. Washington means to attain this objective.

Machine Tools—Groups of machine-tool builders have been called to Washington the past two weeks to discuss with OPM the expeditious handling of the new bomber manufacturing program. Of the half billion dollars worth of machine tools required for this program, all should be delivered by July 1, 1942, and 30 per cent should be in place in production plants by April 1 of next year. Rough estimates are that 6,500 milling machines, 6,000 engine lathes, 1,000 automatic lathes and 1,500 radial drills are among the machines needed. If erection of new defense plants and their tooling up were better planned, lost time from idle machinery would be greatly reduced, point out machine-tool people. In one huge factory recently opened, scores of machine tools stood under canvas for days and weeks before being used. Thousands of productive machine hours thus were lost. Lend-Lease orders continue extremely slow in coming through. They will reach machine-tool companies mostly through district ordnance offices of the War Department. Machine-tool shipments in May were $60,800,000, compared with $60,300,000 in April and $57,400,000 in March. The industry is extremely worried about its dwindling supply of some materials, particularly steel and bearings. Despite the heavy demands on machine-tool builders, some companies have expanded their operations so widely as to take care of the defense emergency that they now are looking for business to keep production on the vast scale currently in effect.

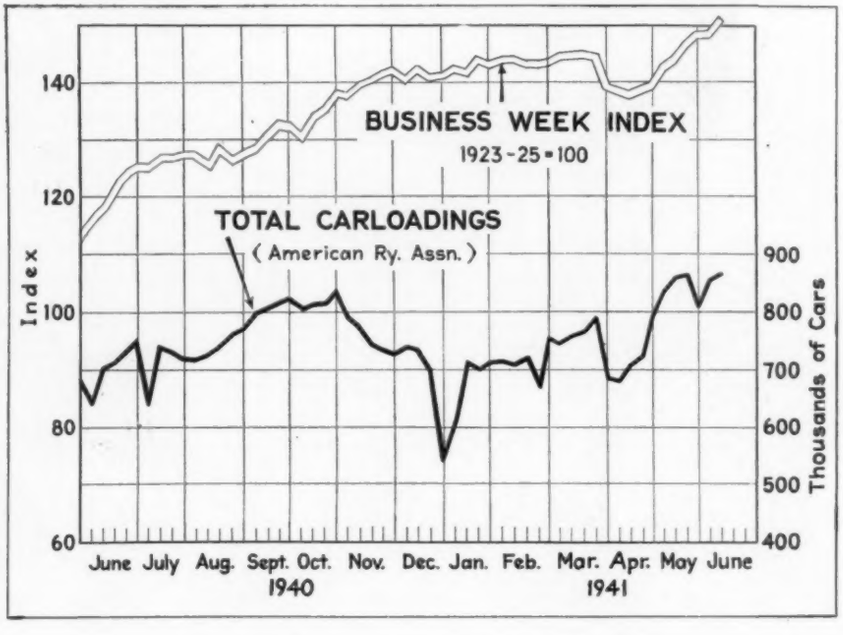
Steel—The scramble for steel, even on the part of defense contractors, is becoming hotter daily. Machine tool builders, with an A-1-a priority, are having difficulty in certain cases getting steel and will have to curtail operations if fresh shipments are not received in the next 30 days. With the number of users having preference ratings growing, the non-defense consumer is rapidly being squeezed out of the market. Revamping of continuous mills to turn out more plate stock for ships and railroad cars will cut down the amount of sheets and strip available for consumer goods.

Railroad Equipment—Orders in the first two weeks of June totaled about 9,000 freight cars and 100 locomotives. This start indicates that the month's volume may be higher than May's, which was the best in years. Looking to 1942, the Pennsylvania expects to build some 6,000 cars and the Burlington has ordered 4,425 cars from its own shops. Wabash has received court authorization to spend over $3,000,000 to build 1,000 cars in its shops. Santa Fe has contracted for three more diesel-electric freight locomotives of the type recently publicized. Pullman-Standard last week completed the first medium-sized tank on an order for 500 for the British. Pettibone-Milliken has produced the first 155-mm. howitzer carriage of an order for 300 for the U. S. Army. The Atlantic Coast Line has placed 2,900 freight cars and the Chesapeake & Ohio 2,000 cars. Car builders now have a blanket priority rating of A-3 covering purchases of materials and equipment except machine tools.

Aircraft—Additional huge orders have been placed with airplane makers, Glenn L. Martin getting a War Department contract for $73,764,450. The Army Air Corps is reported to have adopted a policy, in conjunction with the British, for standardization of parts and equipment. That means limiting the number of models, thus securing higher output by mass production methods. The standardization policy is being applied first to bombers and later may be extended to fighters. Hudson Motor Car has received an educational order for rear fuselage sections for the Martin B-26B bomber to be shipped to the new Martin assembly plant at Omaha, Neb.

Shipbuilding—Ten cargo ships were completed in May, the highest monthly since 1918–1919. Immediate goal is completion of 705 vessels of all types by December, 1943. The Maritime Commission has revised upward its estimate of ship production in U. S. yards for 1942 to 3,500,000 deadweight tons. In the three years ending December, 1943, the volume of merchant ships built in this country is expected to be over 9,000,000 deadweight tons. It is believed that 1,250,000 tons will be produced this year, around 3,500,000 tons next year and 5,000,000 tons in 1943. Some 250,000 workers will have to be added to present forces by shipbuilding concerns. In Eastern yards employees have endorsed a two-year no-strike agreement proposed by OPM.

Farm Equipment—Some equipment lines are sold out for the year. Shortage of materials is reported by some companies which earlier failed to anticipate the current big volume of business. Heavy wheat crops in the Northwest have resulted in a scarcity of binders and other harvesting equipment. Northwest shippers have been told privately that freight cars will not be available in sufficient quantity to handle the huge surplus of wheat.



Reduce Quality of Materials Produced As OPM Attempts More Rigid Priority Control

WASHINGTON—A new device for priority control of materials, quality reduction, is being tried by OPM. It is being used on high speed tool steel and on nickel alloy steel. In each case all users, defense and non-defense, are being required to use a lower quality of material in order to make the strategic material go farther.

Producers of nickel steel have been ordered not to use primary nickel for more than 40 per cent of the nickel content, using secondary nickel for the remainder. Thus at one stroke the alloying consumption of primary nickel is cut 60 per cent. Army and Navy have agreed to modify their specifications to accept the lower grade nickel steel.

A slightly different approach is being taken to high speed tool steel. Here tungsten is the problem. Tool steel has been divided into two classes. Class A, the molybdenum type, consists of steel containing at least .60 per cent carbon, more than 3.0 per cent molybdenum, and less than 7.0 per cent tungsten. Class B steel is to contain at least .55 per cent carbon and more than 12.0 per cent tungsten.

A tool steel user must meet at least half his requirements with Class A steel. Whenever he orders a quantity of Class B, he must, within a three month period, order an equal quantity of Class A. Orders for Class A may not be cancelled without cancelling an equal order for Class B.

Some priority developments include:

Percentage plan: The so-called Defense Supplies Rating Plan will only be extended beyond the present 500 or so mill supply manufacturers as other firms ask for it. Under the plan firms manufacturing for stock, a percentage of whose output goes into defense may obtain priority ratings on the same percentage of the supplies they buy. It had been intended to issue soon another list of firms eligible for the plan, but it has now been decided to let people who want it ask for it.

Steel: Priorities Division ordered steel firms to deliver a total of 469,420 tons to eight shipbuilders and to the British Purchasing Commission.

Ships: Blanket preference ratings, the highest possible, were granted to builders of merchant ships. Ships for completion this year get A-1-a, for completion in '42, A-1-b, and for completion in '43 A-1-c.

Priorities Division Opens Four District Offices

WASHINGTON — A priorities field service has been established to give on-the-spot advice on priority problems to manufacturers in strategic industrial areas. In addition, the Priorities Division of the Office of Production Management, has established four district offices to assist manufacturers and business men in their request for preference ratings. The field organization is headed by L. Edward Scriven and E. C. Laird, Jr., assistant deputy directors of the Priority Division. The four managers and their office locations are:

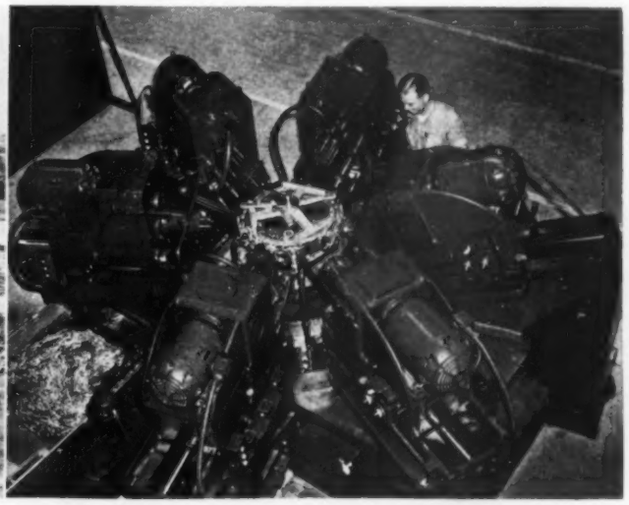
William P. Homans, 30 Pearly St., Boston, Mass.; Phillip M. McCullough, 33 Liberty Street, New York, N. Y.; Frederick W. Slack, 925 Chestnut St., Philadelphia, Pa.; and Warren G. Bailey, 230 So. LaSalle St., Chicago.

OPM Begins Survey of All Machine Tools Built In Past Ten Years; Expands Critical List

WASHINGTON—A survey to determine the present location of all the machine tools built in the past ten years or so is being started by the Office of Production Management. It is intended to take the books of tool manufacturers and track down each of 21 types of tools which are now regarded as critical. OPM is unwilling to make public which tools are included on the list of critical types.

Information as to the whereabouts of critical tools will prove useful upon passage of the Administration's "draft property" bill. Undersecretary of War Patterson told Congress that a major purpose of this bill would be to get hold of tools which are being "hoarded" by owners unable or unwilling to utilize them for defense work.

The draft property bill was temporarily held up by a piece of Congressional slyness. The President some weeks ago attempted to sooth critics of the measure by saying he only wanted it in order to seize strike-bound plants. Congress promptly pigeonholed the bill and went to work on the plant seizure bill described on page 622E. However, the draft property measure is being revived, and the administration is anxious to see it go through.



America's newest and largest aviation plant, the nearly completed 50-acre factory of Wright Aeronautical Corp., Lockland, Ohio, near Cincinnati, has begun the production of the first of the Cyclone 1,700 hp. engines. It will eventually (June 1942) turn out 1,000 of these monthly for the U.S. Built at a cost of $37,000,000, it comprises 2,120,000 sq. ft. and is the largest single story industrial plant in the world. The first Greenlee automatic high production machine (above at right) has been put into operation at the new plant. Six stations machine a supercharger front simultaneouly.

Britain Gets Major Part of U.S. Industrial Output; Explain Procedure of Lend-Lease

WASHINGTON—Since passage last March of the $7,000,000,000 British Aid appropriation total deliveries of goods bought from this money have totalled about $11,000,000, of which some $8,000,000 consisted of foodstuffs. In addition, some $64,000,000 worth of existing stocks or goods on order under previous appropriations have been delivered. These piddling figures do not, of course represent the total deliveries of war goods to the British. Most such deliveries are still being made under pre-lease-lend British orders; lease-lend operations won't assume much importance until the British orders run out. It is fair to assume that a major part of U.S. war industry output is being applied to the fulfillment of these British contracts.

In preparation for completion of the British contracts, about $4,200,000,000 of the lease-lend appropriation has been allocated to specific projects. Of this sum, $1,938,000,000 is for aircraft, $880,000,000 for ordnance, $551,000,000 for ships, and $318,000,000 for tanks and other vehicles. It is not known to what extent these sums have actually been placed under contract, but it is not believed to be large. Except in the case of new projects, such as merchant ships and pilot training, not already covered by British orders, speed in placing of lease-lend orders is not especially significant.

It's perhaps fortunate that speed isn't essential, in view of the complicated procedure through which lend-lease orders must pass.

Procedure is Complicated

First step is for the British Purchasing Commission, in consultation with London and, informally, with the U.S. Army and Navy, to decide what it wants and to make a formal requisition for specific goods to the Division of Defense Aid Reports (Harry Hopkins' outfit). DDAR, after considering the requisition, transmits it for study to the Secretary of the department most familiar with this type of article; in three cases out of four this means the Secretary of War. The Secretary of War turns the requisition over to a Defense Aid Division which has been set up in the office of the undersecretary of war (Patterson). Defense Aid Division refers the question to one of the "Defense Aid Requirements Committees" which has been set up in each of the procurement branches of the Army.

The DARC, with no place else to send the requisition, sits down and decides how the goods can be furnished—whether from existing stocks, by diversion from an existing U.S. order, or by placing a new order. Its finding goes back to Defense Aid Division which prepares a formal recommendation to be signed by the chief of staff and approved by the Secretary of War. It then goes back to Hopkins' Division of Defense Aid Reports.

If it was recommended that the goods be transferred from War Department stocks, then DDAR, after studying the departmental recommendation, submits it to the White House. The President issues a directive to the Secretary of War for transfer of the equipment. From the Secretary it goes to the Defense Aid Division which directs the branch having the equipment to make delivery.

If, on the other hand, a new order must be placed, the White House is bypassed until after delivery is made on the order. Division of Defense Aid Reports arranges with the Bureau of the Budget for an allocation of funds and directs, through the Secretary and the Defense Aid Division, that an order be placed in its regular manner by the appropriate branch of the Army. Arrangements for priorities are made by the Defense Aid Division through the priorities committee of the Army and Navy Munitions Board and the Priorities Division of OPM.

ELECT AMA OFFICERS

NEW YORK—William L. Batt, deputy director, Production Division of the Office of Production Management and president, SKF Industries, Inc., will continue as chairman of the board, and Alvin E. Dodd will continue as president, American Management Assn.

STANDARDIZATION URGED

WASHINGTON — Simplification and standardization of lines of manufactured goods is being pushed by OPM to increase production of existing equipment. It is being promoted for consumers goods in order that civilians instead of being asked to go without can be offered merely a limited choice. In military and producers goods too, reduction of unnecessary size and type variations is being sought in the interests of quick production. Thus OPM recently arranged with screw makers to reduce the number of wood screw sizes from 885 to 507 and to reduce the number of types by 57 per cent. A similar scheme is now being worked out on files. OPM in this effort is making use of the Division of Simplified Practice of the Bureau of Standards, which was set up as an aftermath of the last war. Procedure, much as in normal times, is for representative groups of manufacturers to get together and decide what sizes and styles can be eliminated.

Zinc, Auminum Scrap On Full Priority Control

WASHINGTON—Zinc, a metal vitally essential in defense production, has been put under full priority control effective July 1. The order provides that all defense needs shall be filled ahead of all other requirements, that an emergency pool be created to meet urgent needs, and that the remaining zinc shall be allocated among competing civilian demands. Heretofore zinc had been subject only to partial control through a production pool. Producers have been required to set aside an amount of zinc representing a certain percentage of their production, thus creating a pool out of which the Director of Priorities has allocated to meet emergency situations. The pool for June was set at 22 per cent of the amount produced in April, and approximately 15,000 tons.

Severe Shortage Exists

Available figures indicate that the total supply of zinc in 1941 will approximate 890,000 to 950,000 short tons. The estimated requirements for 1941, however, include military and civilian needs, and are now estimated at 1,165,000 short tons. This indicates an overall shortage of from 215,000 to 275,000 tons for 1941.

Deliveries under all defense orders which do bear a higher preference rating are assigned a rating A-10. Deliveries bearing lower preference ratings, or no rating, must be deferred, to assure deliveries for defense needs. After all defense needs have been assured, deliveries to non-defense orders may be made so long as all terms of the order are complied with. Inventory limitations are included in the order which prevent the building up of excessive and unnecessary stocks.

At the same time aluminum scrap was put under full priority control. Order previously issued controlled the distribution of primary and secondary aluminum, but now virtually all scrap will go to defense channels, except when specific directions are issued by the Director of Priorities to meet special emergencies.

At the same time refinements were made in the copper priority order. Each refiner now must set aside an amount equal to 20 per cent of his April production of duty-free copper, when estimating the amount of copper he must set aside each month in a pool for specific allocation. He may make full shipment to any customer in any month in which that customer's total commitments do not exceed one minimum carload lot. No customer's order need be cut below a minimum carload lot for any one month. Persons who are parties to toll agreements for copper must file information concerning such agreements but need not file full copies and need not obtain specific permission for such agreements.

North American Strike Marks End of Voluntary Settlements; See Need for Coming Legislation

BY ROBERT COLBORN

WASHINGTON — Use of troops to break the North American strike marked a definite end to the Administration's attempt to maintain 100 per cent production in defense plants and at the same time keep its standing as a more or less labor government. For at least a year it's been obvious that when it came to a showdown the Administration would put defense production first. But the President was able to stave off the showdown for a long time, the final effort being the semi-voluntary procedures of the Mediation Board.

Breakdown of the voluntary procedure, at North American, in the Coast shipyards, in the Northwest lumber strike, and at the Cleveland Alcoa strike, precipitated an open drive for labor control. Bayonets to break the Inglewood strike were a demonstration that the President meant business, and from that point a two-pronged drive was initiated, one governmental and one within the unions.

The second of these met a quick setback. The Administration's convenient theory that all labor opposition to its program of wartime controls arose from the radical element was refuted when the relatively conservative Green and Murray issued almost simultaneous blasts against pending anti-strike legislation and Murray flatly denied any intention of carrying out a wholesale purge of officials labelled Communists. Local leaders were going to be held subject to CIO discipline, Murray made clear, but this didn't imply any down-the-line cooperation with the administration. It is evident that Murray is not prepared to split with the strong Lewis faction in the CIO, which demonstrated where it stood when it promptly absorbed the Minnesota teamsters local which fell victim to the AFL's recent attempt at red-purging.

This was a severe blow to the Administration. It had hoped that behind the scenes pressure, plus an inspired press campaign, would force the radicals out of the official labor movement, bringing to unquestioned authority a more conservative leadership willing to play ball.

Provide Legal Weapons

This failure will increase the steam behind the parallel effort to build up an arsenal of legal weapons against defense strikes. Already at hand are the Attorney General's opinion upholding the legality of the North American plant seizure, and the action of the Selective Service Administration in ordering reclassification of deferred draftees who strike in defiance of the Mediation Board.

Pending is the so called plant seizure bill. As passed by the Senate this would permit the President to take over and operate any strike-bound defense plant. The House committee changed this bill to forbid operation of the plant unless the employer refuses to utilize the Mediation Board. The president would be authorized, however, to use troops to break up picket lines, and jail sentences would be imposed on picketers who forcibly prevent men from going to work.

Also pending are House amendments to the War Department's Appropriation which would have the effect of blacklisting from defense industries workers who strike or picket in defiance of Mediation Board rulings. All these approaches to the problem have at least tacit Administration approval. Their common feature is that they give the President powers to use or not as he sees fit.

In a different category, and likely to encounter Administration opposition are two bills which have been pending in Congress for some weeks, the Ball bill and a watered down version of the Vinson bill, from which criminal penalties and the ban on extension of the closed shop have been dropped. Both these bills would establish the Mediation Board as a statutory agency and set up regular procedure, involving a cooling-off period, by which disputes would clear through the board, thus tying the President's hands.

PLANE PRODUCTION FALLS

WASHINGTON — Production of aircraft in May dropped to 1,334, about 50 planes below the April figure instead of 100 above as had been hoped. June output, because of the North American and Aluminum Co. strikes is unlikely to be very much better. There is no big simple cause for the reduced production. Model changes accounted for part of it. Lockheed, which had been turning out about 90 Hudson bombers a month for the British, finished its orders for this and started production on another bomber, the Vega Ventura. Similarly Boeing, turning out 12 to 15 flying fortresses a month, finished production on the B-17-D and started work on the mass production model, the B-17-E. Perhaps more important than these specific delays is the fact that the rapid expansion in plane production over the past couple of months got ahead of the engine, propeller, and accessory producers.

OPEN NEW DISSTON PLANT

PHILADELPHIA — A new $1,250,000 armor plate plant was dedicated last week on the grounds of the Henry Disston & Sons factory in the Tacony area. S. Horace Disston, president of the company, lighted the fires under the boilers which marked the entrance of the armor plate plant into production. Output will be increased 3 times.

Machine Tool Exhibit—*Feeling that the public should know just how machine tools fit into the national defense program, 16 machine tool companies cooperated to build a display in the Miami Valley Industry & Defense Exposition which was held at Music Hall, Cincinnati, May 28 to June 8. The Cincinnati Milling Machine Co., assigned to the chairmanship of the Machine Tool Exhibit, worked out the entire display in cooperation with the R. K. Le Blond Machine Tool Co., and a local advertising display agency. The large "Liberty Bell," (above) illustrating the central theme of the display, was mounted on a slowly revolving circular platform and contained five panels of photographs and captions for milling, grinding, planing, turning and drilling operations*

Canadian Government Seizes Machine Tools Not In Use; Manufacturers Ask Strike Ban

MONTREAL — Government inspectors have been visiting various industrial plants and machine shops for the purpose of seizing all machine tools not in use and to facilitate the transfer of a machine making "non essential" goods to plants in war production. Thomas Arnold, machine tools controller, speaking to manufacturers at the annual meeting of the Canadian Manufacturers' Association recently, explained that the new policy, already in effect for several weeks, was necessitated by war conditions. He indicated that owners of machines which were taken by the government would be allowed to discuss terms of reimbursement at a later date.

Harry Carmichael, formerly vice-president and general manager, General Motors of Canada, and now joint director-general of munitions production, speaking at the same meeting, urged full cooperation in the farming out of contracts and the voluntary lending of tools to war plants. J. L. Ralston, minister of defense, appealed to the manufacturers to adopt policies of using women and older men, to free younger men for military service.

Harold Crabtree, president, the Canadian Manufacturers' Association, in a talk before the group demanded that strikes and lockouts in plants engaged in war production should be definitely prohibited for the duration of the war. At present labor disputes in war plants must be referred to a conciliation board; there has been no legal requirement that the findings of a conciliation board must be accepted.

Few Strikes So Far

So far Canadian plants engaged in war production have not been tied up for more than a few days by strikes. The more serious troubles included the walkout of several hundred employees of Canadian General Electric Co., Toronto, and a strike at Peck Rolling Mills, Montreal, which has lasted over a month. The Canadian General Electric Co. strike, the only case in which strikers refused to heed the labor department's demand that a strike be ended, was terminated when the case was turned over to the government department of justice for action. This department is empowered to impose fines on workers who take part in an "illegal" strike. It can also send to internment camps labor leaders who are considered subversive or undesirable elements. The Canadian General Electric strike was termed "illegal" because it was called without the dispute being referred to a government mediation board. In May the government took over the plant of the National Steel Car Corp., Hamilton, Ont., when the management refused to heed a request for reinstatement of an employee to end a strike. (AM—Vol. 85, p. 506f).

A remarkable similarity characterizes recent orders coming out of Washington and Ottawa regarding raw material regulations. This is attributed to rapid progress already made by the Canadian-American committee seeking to coordinate the supplies of war materials of the two countries. For example, at the same time that Washington placed all types of steel under priority control, Ottawa decreed that all orders on the books of pig iron producers were to be cancelled and new orders must now be routed through the steel controller for approval. Further, almost simultaneous warnings were given in Canada and the U. S. regarding the impending oil shortages in the Eastern part of these countries due to shortage of tanker facilities.

Canada has just begun the delivery of naval gun mountings to the British. The mountings, for naval twin anti-aircraft machine guns, are the first made in Canada. The Dominion is planning to lay keels for two destroyers at the British Columbia shipyards and it is hoped that they will be launched later this year.

Canadian Car & Foundry Co., which has been making Hurricane fighters for the British at its Fort William, Ont., plant, has been steadily switching over its facilities for construction of bombers of the Consolidated type. The initial order is expected to be about $3,000,000. The plant, however, will continue to make Hurricanes until the plant change-over is entirely completed in about fifteen months.

Production has started this month for a new $3,500,000 government plant in Toronto, which will be used for filling fuses for shells.

The following contracts have recently been awarded by the Department of Munitions & Supplies:

Aircraft: Steel Company of Canada, Ltd., $142,229; and Canadian SKF Co., Ltd., Montreal, $76,113. Ordnance: John Inglis Co., Ltd., Toronto, $3,820,000.

SKILLED MEN FOR BRITAIN

WASHINGTON—Emphasis last week was given to Britain's request for thousands of young American volunteers to go over, on a civil job basis, to man Britain's new radio airplane range finders. Not much was said in the U. S. press about the requests for skilled engine fitters, metal workers, electrical technicians, instrument makers and repair men, machine tool setters and operators, motor mechanics and engine room repair men. Obviously the Administration has already agreed to it, although U. S. industry will feel the shortage acutely.

Roosevelt Assails Racial Barrier in Defense Jobs

WASHINGTON—Indicating that complaints have repeatedly been brought to his attention that available and much needed workers were being barred from defense production solely because of race, religion or national origin, President Roosevelt last week called upon the Office of Production Management to take immediate steps to deal effectively with the situation.

"No nation combatting the increasing threat of totalitarianism," he said, "can afford arbitrarily to exclude large segments of its population from its defense industries."

In New York State, Lt.-Gov. Charles Poletti, coordinator of the State Defense Council, indicated that several investigations of complaints of discrimination have been found to be true, particularly in complaints brought by Negroes. He indicated that his agency would "go after" employers and unions when they were involved.

Armco Begins Construction Of New Texas Steel Plant

HOUSTON, TEXAS—The Sheffield Steel Corp. of Texas, a subsidiary of the American Rolling Mill Co. (Armco), began construction recently on a $70,000,000 plant which is expected to get into operation early next year. The plant is scheduled to employ some 1,500 men, with an estimated annual payroll of $2,500,000, and will produce 200,000 tons of ingots annually.

U. S. Steel and Republic Expand Steel Production

PITTSBURGH—The U. S. Steel Corp. will build a $50,000,000 addition to its mills in Homestead and Duquesne to help speed national defense work. "Big Steel" submitted an expansion proposal some weeks ago in Washington before OPM issued its request to the steel industry for an increase in ingot capacity by 10,000,000 tons a year. In view of OPM's request the U. S. Steel proposal is being revised. Construction funds probably will be provided by one of the Federal loan agencies set up for such purposes. Our steel production capacity now is roughly 83,000,000 tons and is expected to be 91,000,000 by Jan. 1, 1942.

The Republic Steel Corp. will construct an addition to its plant which will add 220,000 tons a year to current production. Republic now produces 380,000 tons of 98-in. strip a year, 180,000 tons of it in Cleveland.

The Youngstown Sheet & Tube Co. will add 300,000 tons of steel ingot capacity and some pig iron capacity through an improvement of existing facilities. The work will be completed within six to ten months and the company will bear the expense without Federal assistance.

INSIDE DETROIT

Although some Washington circles advocate further curtailment of auto production, Knudsen and OPM indicate that no new decreases are planned. Materials shortage may cut number of cars

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Tempers in this vicinity, drawn fine over the burdens imposed by a huge slice of the defense program and the worries incident to the uncertain future of auto output, have not been improved by actions and words from Washington. Secretary Knox wants auto production to cease entirely, and asserts that the steel industry has shown favoritism to the auto makers to the detriment of Navy contracts. Assistant Secretary of War Patterson believes that auto production should be curtailed 50 per cent, not 20 as ordered by the OPM. Price Administrator Henderson disagrees with the recent moderate price increases made by five manufacturers and thinks the auto industry can well afford to pay higher wage and materials costs out of profits.

50 Per Cent Auto Cut Denied

Later in the week, OPM co-director Knudsen denied that Undersecretary of War Patterson had requested OPM to seek a 50 per cent reduction in auto production. He said that OPM had no intention of cutting auto production beyond the 20 per cent agreed to previously.

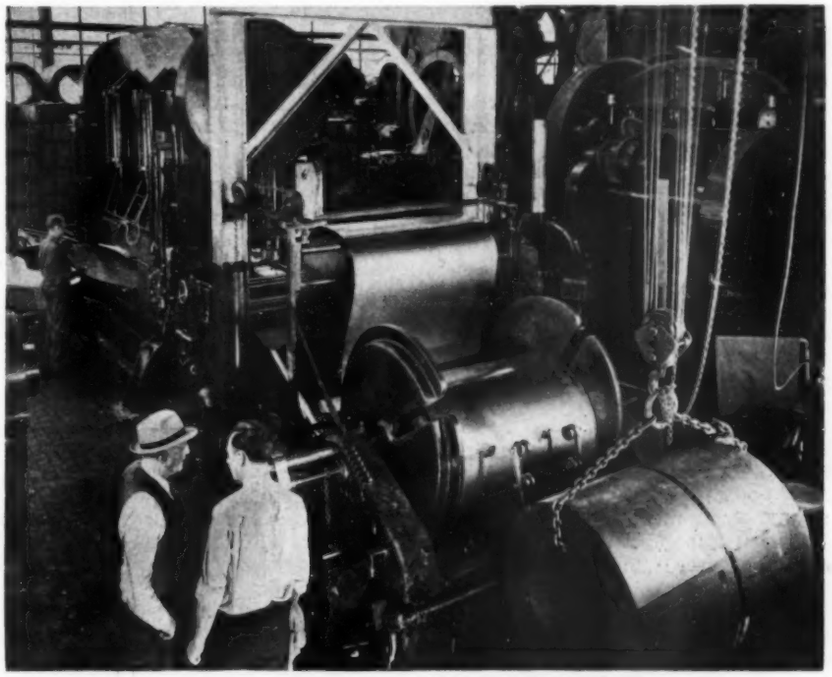
Continued attacks upon the industry for hogging materials are considered unjustified. Automotive men assert that willingness to accept over $2,000,000,000 worth of war contracts shows their loyalty, that Washington can throttle car production any time it pleases by shutting off the flow of materials under the priorities system. Other points of friction do not help the situation. Accustomed to handling large undertakings expeditiously, local people have expressed bewilderment over dilatory tactics in granting a letter of intent for important arms projects. Piddling educational orders have been given instead of production contracts. Arms plants set up ahead of schedule have been publicly acclaimed, but privately the motor car manufacturer has been told not to get too puffed up. While glad to accept a huge plant for arms production, the government has been unwilling to pay for moving the manufacturers' peacetime machinery out of the building. By and large, automotive personnel have taken such matters in their stride as an unavoidable part of getting a great defense effort into being, yet such occurrences do not help to build up a team spirit. This much can be said, where the manufacturer has the capital, millions are being spent to tool up arms projects in advance even of a letter of intent. One company, for example, has spent over $5,000,000 to double plant capacity, although that matter is still in the discussion stage.

The OPM played ball with Secretary Knox by advising thirteen steel companies to curtail production of sheet and strip steel for non-defense purposes and to use the strip mill capacity thus released to turn out more plates for shipbuilding, railway car building and other urgent defense needs. The Ford Motor Co. was on the list. That the steel companies were planning to convert strip mill equipment to plate manufacture has been reported on several occasions. In the order, the OPM states that after all possible defense needs for plates, sheets and strip have been provided on these strip mills, it is planned to continue their operations on such products for non-defense needs up to the ingot capacity available for such purposes. Obviously, autos and refrigerators take a back seat.

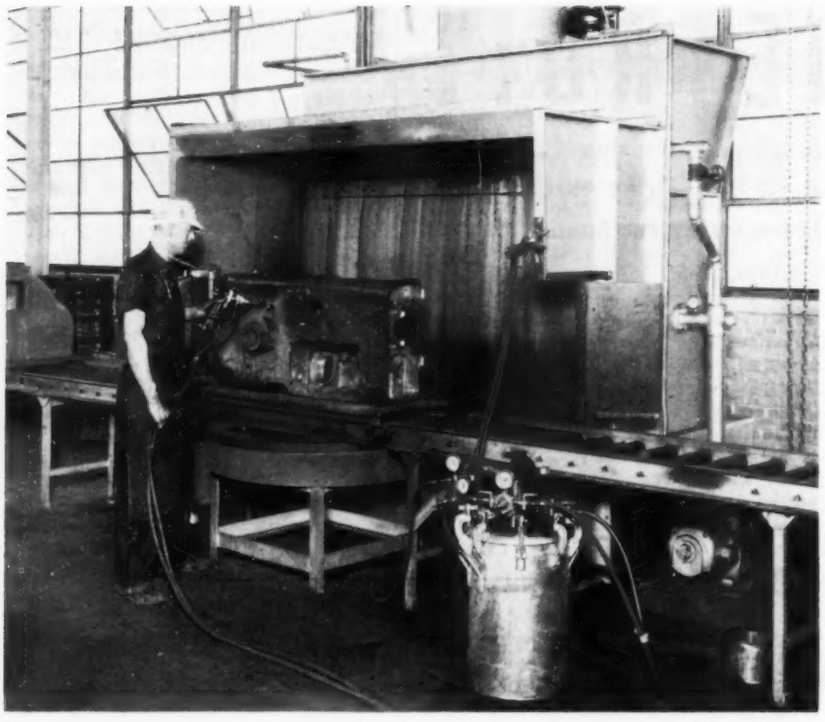
REQUISITION MACHINE TOOLS

DETROIT—Mason Britton, chief of the tool division, OPM, declared here that he had been appointed head of a three-man committee to go out and requisition machine tools from manufacturing establishments not currently making 24-hr. use of them. Despite machine-tool production four times the peace-time peak, Mr. Britton declared "We can't wait for new tools to come off the line." The government is certain that much idle equipment exists, over and above recent surveys, and will take steps to remove such machinery to defense plants.

From auto curtailment programs announced or in prospect, it is obvious that consumption of steel by the automotive industry during the 1942 season will fall well below the levels of 1940, for which figures have just been released by the American Iron & Steel Institute. Out of 45,850,000 tons distributed to consuming industries in the U. S. and exported in that year, the automotive industry took 7,185,000 tons, or 15.7 per cent. Broken down into types of steel, it is shown that motor car manufacture absorbed 20 per cent of carbon bars, 49 per cent of alloy bars, 40 per cent of hot-rolled sheet and strip, 55 per cent of cold-rolled sheet and strip. Steel output in 1941 is scheduled in excess of 80,000,000 tons,



To Go Hungry Soon?—*Typical of the automotive industry's best practice in using sheet steel is this setup at the Chevrolet plant at Flint for producing a pair of rear fender blanks at one stroke. The OPM has asked the steel industry to curtail sheet and strip production for non-defense purposes and to turn out plates for ships*



Healthy Workers—*Go a long way to maintain high production rates in U. S. defense plants. Advances are being made steadily by industry to improve health and working conditions for factory employees. The Cincinnati Bickford Tool Co., which recently completed a new plant addition for sanding, rough grinding, filing and painting castings has installed devices for eliminating dust particles, sand and paint fumes. Noteworthy is the system (above) through which air is suctioned, carrying off impurities. It is capable of carrying off 75,000 cu.ft. of air per minute, while the intakes are adjusted to supply 80,000 cu.ft. per minute*

NO VACATION IN DEFENSE

WASHINGTON—The U. S. Office of Education has established a "no-vacation" policy for vocational trade and industrial schools which are training workers for defense jobs. Many of these schools are operating on a schedule of 24 hours of a day. About 600,000 workers for the expanding defense industries have been trained or are now in training in 1,000 public vocational schools. The Office of Education expects about 1,000,000 persons to be trained in all types of vocational defense training programs by June 30.

Gano Dunn Resigns OPM Post; Made Steel Surveys

WASHINGTON — Gano Dunn, who came to Washington June 3, 1940 as senior consultant to E. R. Stettinius, and who remained to make two reports direct to the President on U. S. steel capacity, has resigned his post to return to his position as president, J. G. White Engineering Corp. Although Dunn's first steel survey revealed that U. S. capacity was ample for estimated demands, OPM and Administration circles were critical and advocated an expansion. After Dunn's second report, indicating that a shortage was likely, OPM and OPACS held a conference with steel executives and proposed a 10,000,000-ton steel expansion program.

but it does not follow that the curtailed automotive needs will not run smack into priorities for more pressing purposes. Besides sheet and strip curtailment in prospect, automotive manufacturers have already had difficulty in getting bar stock because of priorities for shell steel. In respect to alloy bars the auto industry is particularly vulnerable.

Price Administrator Henderson's demand that five automobile companies —Chrysler, Ford, Nash, Hudson and Studebaker—rescind recent price advances drew a stony silence from the manufacturers concerned. Immediately following an eight-cent blanket wage increase, Chrysler lines boosted prices from $10-$53, Studebaker from $15-$25, Hudson an undisclosed amount. Ford upped the price of the V-8 models $15 upon introduction of the six. Nash put into effect a second boost in somewhat over a month, asking from $10-$20 more.

His demand that price increases be withdrawn was not immediately complied with, and it was indicated that auto officials would give considerable study to the problems imposed by his order before action would be taken.

Opinion in automotive circles runs to this effect: (1) the government has shown tender solicitude for increased prices to the farmer and higher wages to the worker but now refuses to allow the manufacturer to recoup higher wage and materials costs; (2) the profit position of several manufacturers is in a precarious position despite a pickup in business; and (3) the additional cost of manufacturing a car is higher than the price increases asked to date.

Increased cost of manufacturing a car which wholesales at $700 is said to be approximately $68. This sum is made up of $18 for higher labor costs, $25 for higher material costs and $25 for more costly materials in process of substitution for strategic materials being conserved for defense needs. Despite a 10 per cent gain in manufacturing cost, the price increase on vehicles in the above price bracket is only $10-$15. General Motors, Packard and Willys escaped involvement in the controversy with the Price Administrator, although they are faced with the same problems.

General Preference Order M-14, issued June 11 by the Priorities Division, OPM, dumps a number of problems on the doorstep of Detroit industry. The order says that: (1) a customer may not order tungsten high-speed steel if the molybdenum type will serve as well; and (2) during any three-month period the customer who wants tungsten steel must take an equal amount of the moly variety. Records must be kept by the producer, the warehouse, and the customer. The purpose of the new order is to conserve tungsten, which may run short before the end of the year.

The Priorities Division demands that enlarged use be made of "Class A" high-speed steel, defined as alloy steel containing not less than 0.60 per cent carbon and containing more than 3.0 per cent molybdenum, or alloy steel containing not less than 0.60 per cent carbon, containing 7.0 per cent or less of tungsten and more than 3.0 per cent of molybdenums. "Class B high-speed steels," which are to be conserved, are defined as containing more than 12 per cent tungsten. Manufacturers desiring a better understanding of these steels, their general composition, producers and tradenames, should consult an article in AMERICAN MACHINIST, "The Working of High Speed Steels" (AM—Vol. 84, page 93).

Warehouses report that stocks of molybdenum steels are currently insufficient to make immediate deliveries in the quantities required, and that deliveries of tungsten high-speed steels have been growing increasingly late in recent weeks. Mills must switch increased capacity to Class A steels.

WATCHING WASHINGTON

U. S. Army will have one motor vehicle for every five men by Christmas. Production now at rate of 20,000 monthly. Interchangeability of parts emphasized in production of motorized equipment

By BLAINE STUBBLEFIELD

WASHINGTON — By Christmas the Army will have 273,912 motor vehicles, one for each five of the present 1,418,000 men. Approximately one-third of these men, between four and five hundred thousand, serving as drivers, mechanics, and servicemen, are engaged in the transportation of the other two-thirds. On June 30, 170,000 vehicles will be on hand. Production is now at the rate of 20,000 a month.

Armies have gone back to the ancient warfare of movement, the tactics of the Greeks, the Barbarians, the Civil War. The World War alone dug in and stood still.

U. S. Best in Wheeled Equipment

No country in the world can match the United States in the production of wheeled war equipment. Our superior motor industry is one reason why the Quartermaster's vehicle procurement is out in front of any other munitions program in Washington. The other reason is that Quartermaster's transportation division, headed by Brig. Gen. J. E. Barzynski, was up on its toes months before the big push, making contracts and new designs.

The Army has two general kinds of motor vehicles. One is "mechanized" or armored division equipment, which consists mostly of tanks. Soldiers ride and fight in these machines. The other kind is "motorized" equipment, whose function is simply hauling. Men ride to battle in it, but they don't fight in it. This story is about the Army's motorization.

To classify still further, there are two kinds of motorization: One is "administrative" which means mostly passenger automobiles and a few trucks. These are almost standard commercial chassis. You simply order the cars with olive drab paint; it's almost that simple. The full vehicle quota includes 6,231 automobiles and some motorcycles. A mere drop in the bucket.

The other kind is "tactical vehicles," those which accompany the Army in the field. Tactical vehicles are the big volume, and the big problem, because they are not commercially standard. There are six sizes of tactical trucks: ¼-ton; ½-ton; 1½; 2½; 4 and 6-ton.

The main difference between commercial and military trucks is the all-wheel drive, which the Army is adopting throughout. No mathematical equation has been set up but apparently four wheels driving give far more than double the traction of two. Maximum traction is important because transportation must leave the roads and go where the Army goes. Four-wheel steering was abandoned long ago, because such a truck, up against a street curb, could not get away.

Army Developed All-Wheel Drive

Army had to develop the all-wheel drive because industry doesn't use it extensively; it's not necessary on regular roads. Six-wheel drive is complicated. The engine drives through a conventional transmission into a "transfer case," a sort of gear jack, just back of the engine. Out of the transfer case goes a shaft to the front axle differential, which is off center. Back from the same transfer case goes another shaft into both of the rear axles. Or, in some designs, two shafts run separately to the rear axles, both of which have differentials. Because there is no differential in the transfer case, all three axles must turn at the same speed. When the truck is not loaded, and the center of gravity is far forward, the front wheel tires flatten down, giving them a smaller diameter. Result is that there is a "scrubbing" action on the front tires. This is prevented, when the truck is on good roads, by an automatic de-clutching of the front axle. Front wheel drive is not needed, anyway, on hard roads. When the front wheels are out, the lowest drive cannot be engaged.

This specialization for the Army created many problems. In a recent letter to the Army and Navy Journal, General Barzynski said that in the first year of the program, Army would require over 200% more of the 2½-ton trucks than the industry has been selling annually. It was a question whether the industry *could* build enough medium and heavy trucks, and whether it would be willing to do so, and run the risk of losing its regular customers who wanted something else. A bottleneck threatened in special component parts, such as constant-velocity universal joints, and transfer cases. All these were met.

Next in importance to all-wheel drive is standardization and interchangeability of parts. A lesson was learned on this in the World War, when 216 makes of vehicles were used, including many foreign ones. This number has been reduced to 16, which are variations on the six basic types. Maintenance in the field is vastly simplified.

Manufacturers now producing, and those who may, have worked out a plan for interchangeability of parts in common. This was accomplished in conference over the last 9 months, with the Army and the Society of Automotive Engineers. Standardization is applied also to gasoline, three types of which are now used instead of four; there is hope that this can be cut to just one: probably 80 octane, and one diesel fuel. Engine oil types have been cut from eight to three; transmission oils, four to two; grease from five to three. Repair equipment includes 22 different types of tool sets.

Of course spare parts constitute a big job in themselves. Gen. Barzynski says that Britain figures on parts costing 20 percent of the original vehicle cost. Our own Quartermaster figures that $100,000,000 worth of vehicles will take $18,000,000 worth of parts, or 18%.

Large Wheel Contracts Let

Authorized news men can see the Army vehicle order sheet in Washington, but publication of contract totals is forbidden. Running down the columns you see such contracts as 8,900 two and one-half ton 6x6 (first figure is number of wheels; last one, the number it drives on); 4,900 one-half ton 4x4; 7,000 two and one-half ton 6x6; 3,000 one-half ton 4x4; 3,300 motorcycles. Incidentally, the ¼-ton truck will displace a great many tricycle and side-car motorcycles, but not the two-wheelers.

Most impressive item the writer saw was a $30,000,000 contract with Yellow Truck and Coach for 2½-ton six by sixes. There might be bigger totals if the scores of items were added up. Nash-Kelvinator has a $3,121,245 contract for one-ton, two-wheel trailers; Fargo Motor Co., $3,767,070 for one-half ton four by fours with pickup body.

One of the engineers told the writer that Ford, American Bantam, and Willys-Overland are dominant builders of the ¼-ton four by fours. Fargo is top on ½-ton 4x4; on 1½-ton 4x4 it's Chevrolet; Yellow Truck works on 2½-ton 6x6; Federal Truck makes variations in the four to five-ton trucks and trailers; four-ton 6x6 goes to Diamond T; five and six-ton 4x4 are built by Mack International and Autocar; six-ton 6x6 are contracted with Mack and Corbett.

In addition to procurement for the Army, every branch of which uses motor vehicles, there is production for the British. To date, since enactment of Lend-Lease, $3,000,000 worth of Army vehicles out of stock have gone to Britain, and $400,000 worth paid for from Lend-Lease money. Allocated under Lend-Lease is $46,000,000 for trucks and $3,710,000 for automobiles.

Lose 2,000,000 Man-Days By Strikes in 6 Months

WASHINGTON—Scattered strikes of all kinds in private industries working on ordnance and materiel contracts for the U. S. War Department caused a loss of over 2,000,000 man-days of labor between January 1 and June 10. No comparable figures are available from the U. S. Navy, but many of the manufacturers counted by the War Department on its list, also manufacture items for the Navy. Also, the figures do not include details of strikes in shipyards. Secretary of the Navy Knox, and William S. Knudsen, director of the Office of Production Management, believe that defense strikes will now begin to taper off as government mediation machinery functions more effectively. Congress feels that public opinion is against strikes tying up production in needed industries.

Heavy July Schedules Seen for Auto Plants

DETROIT — Production of approximately 540,000 cars and trucks in June seemed assured until a jurisdictional dispute arose between the AFL and CIO auto-workers' unions at Douglas & Lomason, Detroit parts supplier. This company supplies most of the auto plants, and it was undeniably true that an imminent shut-down or curtailment of assembly lines was in prospect unless Washington authorities could bring the two unions to agreement upon a new election. The parts supplier was in the middle, with the AFL fighting to retain its hold on the workers and the CIO maneuvering to clean out one of the few remaining AFL shops in the auto industry.

From present indications, July will be an exceptional month for auto output. General Motors division will account for approximately 90 percent of June production, it is said. Ford will attempt to continue the six-day week but may taper toward the latter part of the period. Materials supply and operation of the motor line are criteria in maintaining operations at the Rouge. Despite contract negotiations conducted apparently in a harmonious atmosphere, slowdowns are recurrent in the motor assembly department. Typical of the independent's view of the situation is that of Packard, which will continue 1941 assemblies right through July and start up 1942 assemblies on August 1. Staggered closings and reopenings of departments will permit an almost uninterrupted assembly process during the model changeover, as compared with previous years when the plant was closed for extended periods. Other manufacturers will shut down the last week of July, re-open after a normal changeover period. New cars in several instances will not be made until September.

NOMINATE ASTM OFFICERS

CHICAGO—G. E. F. Lundell, chief, chemistry division, National Bureau of Standards, Washington, D. C., has been nominated for president, 1941-1942, the American Society for Testing Materials. Dean Harvey, materials engineer, Westinghouse Electric & Mfg. Co., has been nominated for the two-year term as vice-president. Nominations for membership on the executive committee are: Arthur W. Carpenter, manager, testing laboratories, The B. F. Goodrich Co., Akron, Ohio; T. A. Fitch, director, Bureau of Standards, Los Angeles, Calif.; Carl D. Hocker, plant products engineer, Bell Telephone Laboratories, New York, N. Y.; J. L. Miner, director and vice-president, Atlas Lumnite Cement Co., New York, N. Y.; E. W. Upham, Chrysler Corp.

House Votes $16,000,000 For Training Technicians

WASHINGTON—Continuation of the "Training Within Industry" engineering program of the U. S. Office of Education on an enlarged and extended scale seems assured by the passage, in the House, of a bill appropriating $16,000,000 for this purpose. No opposition is indicated in the Senate, with prospects that the bill will be passed and signed by the President in the next few days. This total compares with $9,000,000 for less than a full year in the present appropriation. Indications also were made to the effect that if the $16,000,000 was insufficient, more money might be available in a deficiency appropriation. The pending bill authorizes the addition of chemists, physicists and production-supervisory candidates to the engineering courses Colleges not heretofore eligible to participate may now do so.

U. S. Government Contracts Awarded to Metal-Working Firms

(*Does not include contracts under* $100,000)

Source	Ageney	Commodity	Amount
Bethlehem Steel Co., Bethlehem, Pa.	Navy	Gun forgings	$1,799,988
Chicago, Rock Island & Pacific Railway Co., Chicago, Ill.	War	Second hand rails	187,113
Metal Specialty Co., Cincinnati, Ohio	"	Ammunition, antitank parts assembly	248,000
Bridgeport Brass Co., Bridgeport, Conn.	"	Cartridge cups	1,574,275
American Brass Co., Waterbury, Conn.	"	Cartridge disks	246,951
Revere Copper & Brass, Inc., Rome, N. Y.	"	Machined forged brass ring	307,500
Clyde Iron Works, Inc., Duluth, Minn.	Navy	Jib cranes	216,000
Harnischfeger Corp., Milwaukee, Wis.	"	Bridge cranes	102,590
Davenport Besler Corp., Davenport, Iowa	War	Locomotives	421,425
Treadwell Construction Co., Midland, Pa.	Navy	Roller assemblies	952,200
General Electric Co., Schenectady, N. Y.	War	Tank propulsion equip.	229,558
Curtiss-Wright Corp., Buffalo, N. Y.	"	Airplanes	20,444,414
Fairchild Engine & Airplanes Corp., Fairchild Aircraft Div., Hagerstown, Md.	"	"	4,746,951
Vultee Aircraft Inc., Downey, Calif.	"	"	32,912,990
Bendix Products Div. of Bendix Aviation Corp., South Bend, Ind.	Navy	Carburetor parts	270,000
Eclipse Aviation Div. of Bendix Aviation Corp., Bendix, N. J.	"	Boxes, coils	1,260,000
Chrysler Corp., Detroit, Mich.	War	Nose fuselage section	5,336,835
Beech Aircraft Corp., Wichita, Kans.	"	Airplanes	6,171,000
Snap-On Tools Corp., Kenosha, Wis.	"	Wrenches	216,250
The Midvale Co., Philadelphia, Pa.	Navy	Gun forgings	1,962,314
American Locomotive Co., New York, N. Y.	"	Breech plug and mushroom forgings	210,411
Allis-Chalmers Mfg. Co., Milwaukee, Wis.	"	Breech block forgings	122,948
Crucible Steel Co. of America, New York, N. Y.	"	Gun barrel forgings	808,500
Heppenstall Co., Pittsburgh, Pa.	"	Breech housing forgings	331,731
Erie Forge Co., Erie, Pa.	"	" " "	576,783
Pennsylvania Forge Corp., Philadelphia, Pa.	"	" " "	108,080
Camden Forge Co., Camden, N. J.	"	" " "	121,298
Struthers Wells-Titusville Corp., Titusville Forge Div., Titusville, Pa.	"	" " "	110,773
National Forge & Ord. Co., Washington, D. C.	"	Breech block forgings	104,692
Fulton Sylphon Co., Knoxville, Tenn.	"	Cartridge cases	617,573
U. S. Hoffman Machinery Corp., New York, N. Y.	"	Aluminum tubes	365,650
"Quick-Way" Truck Shovel Co., Denver, Colo.	War	Truck cranes	361,422
D. W. Onan & Sons, Minneapolis, Minn.	"	Generator sets	146,900
American Locomotive Co., Washington, D. C.	"	Locomotives	286,750
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio	Navy	Lathes	503,252
Wms. Oil-O-Matic Heating Corp., Bloomington, Ill.	War	Hydraulic units	1,565,930
Gilbert & Barker Mfg. Co., Springfield, Mass.	"	Fuse setters	444,436
American Car & Foundry Co., New York, N. Y.	"	Tank cars	223,750
Continental Motors Corp., Muskegon, Mich.	"	Tank parts	290,418
Yale & Towne Mfg. Co., Philadelphia, Pa.	Navy	Crane trucks	155,610
Automatic Transportation Co., Chicago, Ill.	"	" "	114,480
W. & L. E. Gurley, Troy, N. Y.	War	Transits	101,480
Builders Iron Foundry, Providence, R. I.	"	Telescope mounts	385,552
Remington Arms Co., Bridgeport, Conn.	"	Cartridges	262,562
Veit & Young, Philadelphia, Pa.	"	Dies	125,340
Glascock Bros. Mfg. Co., Muncie, Ind.	"	Mines	246,000
Noblitt-Sparks Industries, Inc., Columbus, Ind.	"	"	244,000
Faultless Caster Corp., Evansville, Ind.	"	Fuzes	331,500
Kingston Products Co., Kokomo, Ind.	"	"	330,000
Motor Wheel Corp., Lansing, Mich.	"	Shells	307,650
Buhl Stamping Co., Detroit, Mich.	"	Mines	232,000
Ryerson & Haynes, Inc., Jackson, Mich.	"	"	253,750
Triumph Explosives, Inc., Elkton, Md.	"	Detonator assemblies	425,000
The Tredegar Co., Richmond, Va.	"	Shells	175,536

NAMES in the NEWS

Manage Plants at Allegheny Ludlum Steel

CARL B. POLLOCK

MELVIN C. HARRIS

V-P Gordon-R Co.

LLOYD L. LEE

E. L. Bates vice-president and a member of board of directors, has been named director of sales, Fostoria Pressed Steel Corp., Fostoria, Ohio.

C. W. Bergquist, for 13 years superintendent of public relations, Hawthorne Works, Western Electric Co., has been named manager of the company's newly organized division of industrial and personnel relations. A P. Lancaster has been made superintendent of industrial relations, and E. J. Skitt, superintendent of personnel service.

George W. Borg has resigned as chairman of the board, Borg-Warner Corp., Chicago, because of the increasing burden of other duties in connection with national defense. C. F. Davis, president, has assumed Mr. Borg's responsibilities.

B. D. Christian, formerly vice-president and general manager, Safway Steel Scaffolds Co., Milwaukee, Wis., has been elected president.

R. M. Cleveland has been appointed manager of the Boston Office, Worthington Pump & Machinery Corp., Harrison, N. J. He succeeds W. A. Finn who has been called to active duty with the Navy.

M. R. Crossman has been named director of the newly created industrial advertising division, the Cramer-Krasselt Co., Milwaukee, Wis. He has been associated with the company for 13 years.

W. E. Griffiths will manage the newly created Development Engineering department, Allegheny Ludlum Steel Corp., Pittsburgh. W. F. Detwiler, Jr. has been named assistant manager. Other personnel changes made recently in the organization include: Melvin C. Harris who has been appointed district manager in charge of all Pittsburgh area plants; Carl B. Pollock who has been appointed manager of the company's plant at Brackenridge, Pa. while George W. Evans has been named general superintendent; Howard M. Givens, Jr. has been named manager, tool steel sales; and Stanley A. McCaskey has been elected assistant secretary of the corporation.

Norman L. Deuble, formerly assistant to the vice-president, Copperweld Steel Co., Warren, Ohio, has been appointed manager of sales.

H. E. Doughty has been appointed manager of the recently established Philadelphia Branch of the Jessop Steel Co., Washington, Pa.

Vernon R. Drum has been elected vice-president in charge of manufacturing, Willys-Overland Motors, Inc. Mr. Drum began his automobile career as a toolmaker in 1908. From 1920-24 he was chief inspector at Willys-Overland. He then joined the Chrysler Corp. as operations manager in the Jefferson plant in Detroit. Before returning to Willys-Overland as operating manager last December, he was president of the Logan Gear Co.

Robert S. Furst has been named personnel director, Adel Precision Products Corp., Burbank, Calif.

I. F. Holland, superintendent of the small tool and gage production, Pratt & Whitney Div. of Niles-Bement-Pond, West Hartford, Conn. has been named chairman of the editorial committee, American Society of Tool Engineers.

Arnold C. Keller, treasurer, the International Harvester Co., Chicago, has been elected vice-president and treasurer. Carl O. Schreiber, assistant to the vice-president in charge of manufacturing, has also been elected vice-president. Mr. Schreiber will have supervision over the manufacturing department, industrial relations department, and industrial engineering and construction department.

James S. Knowlson, president and board chairman of Stewart-Warner Corp., Chicago, has been reelected president, Radio Manufacturers' Association. James T. Quan, Quan-Nichols Co., has been elected vice-president.

Lloyd L. Lee, formerly with Wilcox-Rich Div., Eaton Mfg. Co., has been elected vice-president, the Gordon-R-Co., Royal Oak, Mich.

Charles C. Limbocker, chairman of the board, Wolverine Tube Co., Detroit, Mich., has been elected president. He fills the vacancy of H. J. Hooks who has resigned. Mr. Hooks had been associated with Wolverine since 1919, first as secretary and treasurer, and later as president. George H. Klein has been elected to the board of directors to fill the vacancy created by Mr. Hooks' resignation.

J. G. Gilbert Lodge, governing director, Gilbert Lodge & Co., Ltd., London, is in the U. S. for the next several months to visit the 20 machine tool builders whom his firm now represents in Australia and New Zealand. He is also seeking additional non-competitive lines. His address is in care of Chase National Bank, New York, N. Y.

Peter V. Martin has been appointed superintendent of the Gary Steel Works blast furnaces, Carnegie-Illinois Steel Corp. He succeeds the late W. H. Geesman.

Allison Miller has been appointed assistant sales manager, Truck Div., Dodge Bros. Corp.

Samuel T. Nicholson has retired as chairman of the board, Vulcan Iron Works, Wilkes-Barre, Pa., after 55 years of continuous service with the company. He will, however, continue in a consulting capacity. Robert T. Dunlap has been appointed general manager.

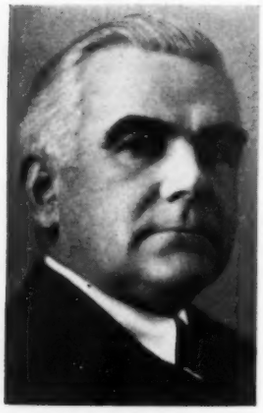
A. W. Parker, after 54 years of continuous service, has retired from the Worthington Pump & Machinery Corp.

Myron Powers has been appointed manager of purchases, the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

Walter L. Rice has been appointed vice-president, Reynolds Metals Co., Richmond, Va. He was formerly special assistant to the attorney-general of the U. S.

W. L. Schneider has been appointed vice-president in charge of sales, the Falk Corp., Milwaukee, Wis. T. F. Scannell has been named sales manager and J. B. Kelley has been appointed assistant sales manager.

Reginald Washburn, formerly president, the Washburn Co., Worcester,



BENJAMIN O'SHEA

JESSE J. RICKS

Their elections as president and chairman of the board, respectively, Union Carbide & Carbon Corp., were announced in these columns

Mass., has resigned and has been named chairman of the board. John S. Tomajan has been elected president to succeed Mr. Washburn. Mr. Washburn has also resigned as president, Andrews Wire Works of Canada, Ltd., Watford, Ont., and the Michigan Wire Goods Co., Niles, Mich. He will, however, continue as general manager and director of these companies.

R. D. Yoder has been transferred from the Milwaukee headquarters of Copper-Hammer, Inc., to the company's Cincinnati office.

PLANT EXPANSION

The Diamond T Motor Car Co., Chicago, which has government orders exceeding $45,000,000 for trucks, has expanded its operations by the opening of a new $200,000 plant.

Greenfield Tap & Die Corp. has recently opened a new building and equipment to increase its production of gages.

Hartley Wire Dies Co., Thomaston, Conn., will increase its factory floor space 100 per cent to accommodate new equipment for the production of shapes and special dies.

Hygrade Sylvania Corp., Salem, Mass., will build a $500,000 fluorescent plant at Danvers, Mass. The plant will be geared for a production capacity of over 100,000 fluorescent lamps per day.

Littlefuse Corp., Chicago, Ill., will build a new factory unit at El Monte, Calif.

Los Angeles Shipbuilding Co., Los Angeles, will expand its facilities at a cost of $800,000.

The Nebel Machine Tool Co., Cincinnati, Ohio, has just completed a new plant addition.

U. S. Aluminum Co., Fairfield, Conn., is rapidly equipping manufacturing units which have been acquired from the Crane Co. at Bridgeport, Conn. The manufacture of aluminum and magnesium casting for airplanes will begin within 30 days.

United Tool & Die Co., Hartford, Conn., has purchased two, one-story brick buildings from the New Departure plant, Elmwood, Conn. The unit will be occupied by the Acme Tank and Welding Div. of United Tools.

BUSINESS ITEMS

Aeronautical Trading Co., formerly of Floyd Bennett Field, Brooklyn, N. Y., is now located at 229-10 Rockaway Blvd., Springfield Gardens, N. Y.

The Cleveland Automatic Machine Co., Cleveland, Ohio, has moved its New York office to American Insurance Building, 15 Washington St., Newark, N. J.

The Standard Thread Equipment Co., 861 So. State St., Jackson, Miss., has been appointed authorized distributor for the Hoist and Body Div., Garwood Industries, Inc., Detroit.

Vega Airplane Co., will build a new commissary building at a cost of $28,000 at Burbank, Calif.

The Suprex Gage Co., Pleasant Ridge, Mich., has been organized by N. A. Woodworth, president of a company which bears his name. He is also president of the Suprex Co. while William F. Klemm has been appointed general manager. N. A. Woodworth founded the Ex-Cell-O Corp. in 1919 and served as its president until 1937.

OBITUARIES

DUDLEY B. BULLARD

Dudley Brewster Bullard, vice-president, the Bullard Co., Bridgeport, Conn., died on June 10 after a long illness. Mr. Bullard was the oldest of five brothers who carried on the business which was founded by his father, Mr. Edward Payson Bullard, Sr. Mr. Bullard had been vice-president in charge of engineering for a number of years. He had been a member of the American Society of Mechanical Engineers.

Edward G. Buckwell, 83, formerly secretary and manager of sales, the Cleveland Twist Drill Co., Cleveland, Ohio, died recently.

Jacob Burger, 67, superintendent, the Erie Forge & Steel Co., Erie, Pa., died suddenly on June 10.

Thomas Alfred Finn, 49, vice-president, Cap, Screw & Nut Co., Inc., New York, N. Y., died on May 28.

R. A. F. Hart, 70, president, Rodger Ballast Car Co., Chicago, died on May 27. He had been president of the company since 1906.

J. C. Kilroy, 57, secretary-treasurer, Lustrow Coated Sheet Co., Pittsburgh, died on June 4.

Frank C. Randall, head of the former machine company which bore his name, died May 26.

J. F. Roche, Jr., a director and vice-president, Binks Mfg. Co., Chicago, Ill., died recently following an operation for appendicitis.

MEETINGS

Conference on Industrial Relations. Silver Bay on Lake George, N. Y., July 23-26.

SHOP EQUIPMENT NEWS

Cleveland Hobbing Develops New Principle In "Rigidturner" Vertical Turning Machines

A new machining principle, known as mold turning, for high-production turning of multiple-diameter work having straight, tapered or formed sections, has been incorporated in the new "Rigidturner" vertical turning machine of the Cleveland Hobbing Machine Co., 1170 East 152nd St., Cleveland, Ohio. Single- and eight-spindle production machines incorporating this principle are being built for purposes such as turning diameters and tapers on cluster-gear shafts, turning the spherical end on variable-ratio universal joints, and turning the complete contours of shell. Main advantage of the machine is that inexperienced help can be used to operate it.

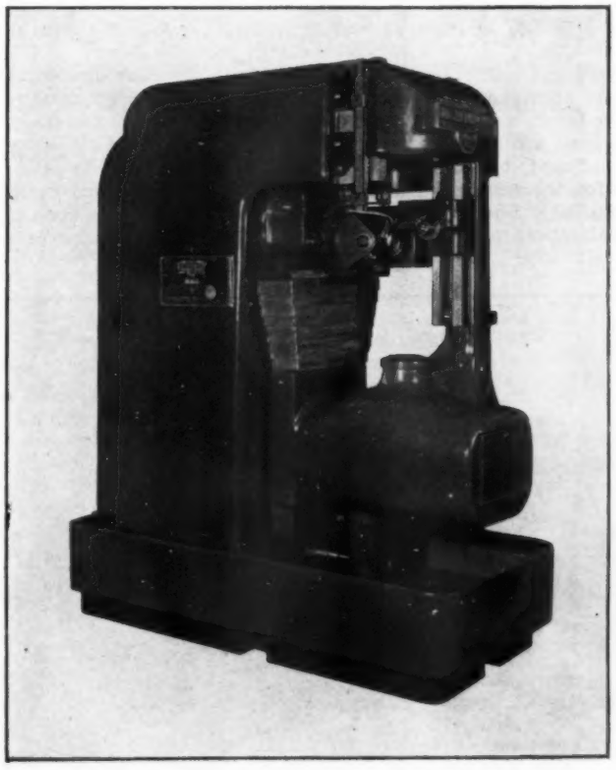
The principle of turning might be described as a disk-type form cutter rolling along the work piece, which is rotated and fed vertically past the tool. The cutter is held in a bracket and makes only a partial revolution to a complete work pass. A cam plate fixed at one side of the knee travels with the work, and constrains a roller in the cam slot which rotates the cutter through a rack drive. Rotation of the tool slows down or speeds up as dictated by the cam slot. Accurate layout of the cam and cutter permits accurate starting of the cut, cutting of straight and tapered sections of exact length, generation of square cut shoulders, and chamfering.

In the Rigidturner, the knee is guided by vertical ways on the lower part of the column. Knee extension is guided by a second set of ways on the upper part of the column. Workpiece is held vertically between a special driver on the knee and a tailstock center. The tailstock can be quickly clamped and unclamped while loading.

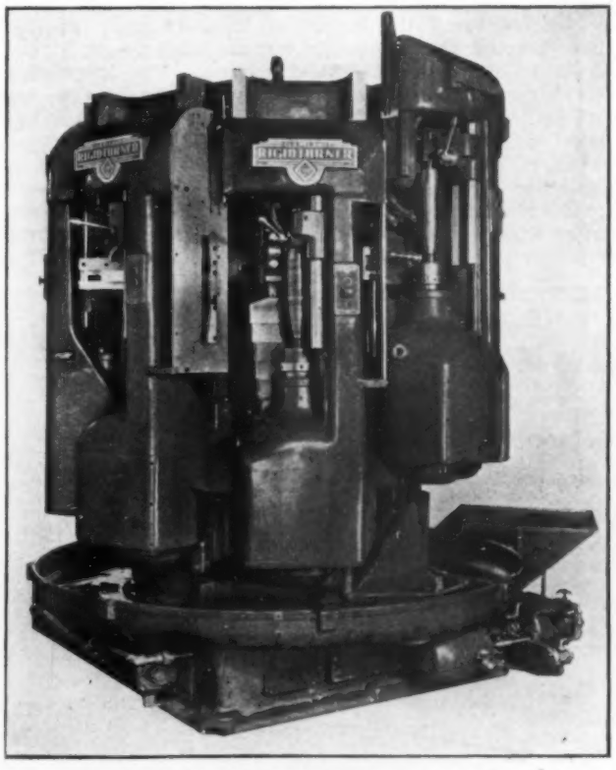
The main drive motor is inside the column. Spindle drive and vertical feed of the knee lead-screw are interlocked to obtain a constant work feed per spindle revolution, regardless of spindle speed. Limit switches can be set so that the motor is automatically speeded up or slowed down at each change in work diameter in order to maintain the closest approach to the ideal cutting speed for the material being machined.

Two pairs of pick-off gears are contained in the front of the work-head. One pair changes the spindle speed to

Principle of "mold turning" is illustrated in these four views which show relative positions of cutter and work at various stages of the cut



Vertical lead screw in the knee of this single-spindle Rigidturner feeds work past the disk-type cutter mounted on the horizontal arbor. Speeds and feed can be automatically controlled for maximum efficiency



Chip guard of this 8-spindle rotary Rigidturner is removed to show set-up for high-production turning of shell. In the rotary machine, knee lead-screw is replaced with a barrel-cam around the base

secure any speed between 50 and 1,000 r.p.m. in conjunction with the four-speed motor. The other pair establishes desired feed per spindle revolution. The Rigidturner can take off ¼ in. of metal in a single cut from automotive forgings. Frequently one cut attains satisfactory dimensional accuracy, finish and a small degree of run-out. The cut is distributed over several inches of tool contour, and this aids tool life. Approximately 400 automotive transmission shafts have been machined per grind, and the tool can be ground twenty times.

Changing from a dull tool to a sharp tool can be done in less than three minutes. In changing from one job to another, it is only necessary to put on the proper cutter and cam and to indicate the tooling. Complete change-over can be done within an hour.

For flexibility, the single-spindle machine is driven by a four-speed motor. These speeds can be controlled manually or automatically as desired. On the eight-spindle rotary machine all of the above features are incorporated with the exception that a two-speed motor is usually specified to simplify the design. Maximum travel for the single-spindle is 16 in.; for the rotary, 18 in. Maximum diameter is 6 in.

Special Set-Up for Shell

For shell turning, the rotary machine with a different type of head and a carbide tool is used. This head is operated from a cam which has the shape of the shell to be turned. A single tool turns the length of the shell, keeping the number of adjustments to a minimum. The machine has a capacity up to and including 105-mm. shell. On the 75-mm. shell these machines have averaged 185 pieces per hour over an eight-hour day. For turning bands, the single-spindle machine with the mold turning cutter is successfully being used.

Sundstrand Equips Model 10 Automatic Lathes For Special Shell-Turning Operations

Two specially equipped Model 10 automatic lathes have recently been furnished by the Sundstrand Machine Tool Co., Rockford, Ill., for high-production turning operations on shell. One of these lathes is designed for rough and finish turning the outside diameter and facing both ends, all in one chucking, of the 3-in. AA shell made from tubing. The other lathe is set up for turning the copper rotating band on four different sizes of shell. Both of these machines have the regular automatic cycle of rapid approach, feed, rapid return, and stop all timed and interlocked with the starting and stopping of the machine.

Turns 18 Shell Per Hour

Operation of the lathe for turning 3-in. AA shell is as follows: The rough shell is held on an expanding type mandrel attached to the machine spindle. This mandrel has two sets of three pins which expand on the inside diameter of the part; one set grips and drives the work while the other set centralizes the part from the opposite end. The outer end of the mandrel has a pilot which registers in a support bushing in the tailstock. The tailstock support is mounted on an air operated slide so that it can be positioned quickly. The shell is positioned endwise on the mandrel by means of a swinging type locator attached to the headstock.

The longitudinal feeding front carriage has a cam-bar actuated tool slide on which is mounted a turret type tool block. Two tools are carried in this block; one is used for the rough cut, the other for the finishing cut. In between cuts the operator indexes the turret type tool block. The complete outside diameter of the shell including the ogive is turned in this operation.

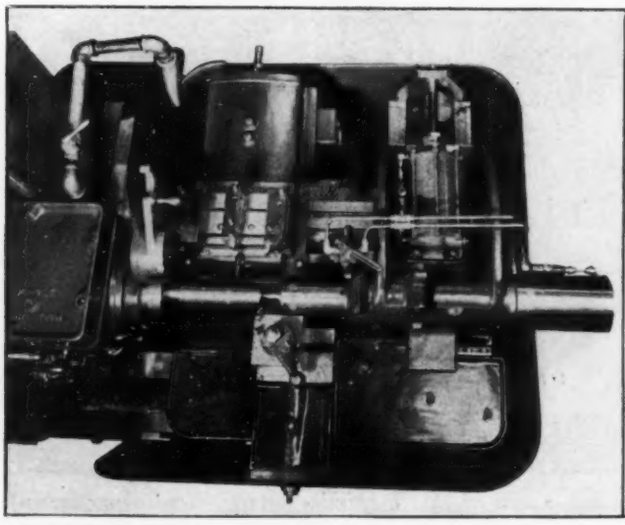
Three tools are carried on the cross feeding rear tool slide. The two outermost tools face the end of the shell to length. The center tool produces the shoulder on the bourrelet. Production with tungsten-carbide tipped tools, speed of 280 ft. per min., and feed of 0.020 in., is 18 pieces per hr. at 85 per cent efficiency.

Turns Bands of Four Shell Sizes

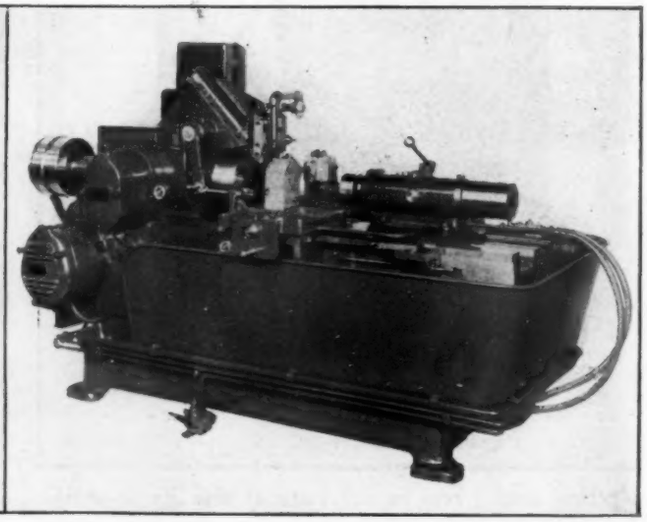
The Model 10 automatic lathe, equipped for turning the copper rotating band, handles four different sizes of shell: the 105-mm, the 155-mm., the 5-in. common projectile, and the 5-in. AA Navy shell, all having different types of bands. Tooling, however, was made as universal as possible so that only a small amount of time is required for changing over the machine. Operation of this lathe is as follows:

A three-jaw air operated chuck is attached to the machine spindle. This chuck has a set of form fitting jaws for each different size of shell. These jaws grip on the outside taper diameter of the boat-tail and have a shoulder which locates the shell endwise. The nose end of the shell is supported in a cup type center which is moved into and out of position by an air cylinder.

To the standard longitudinal feeding front tool slide is mounted a double-deck tool block which carries two tungsten-carbide tipped turning tools so that a rough and finish cut is taken over the band surface with one cycle. On the cross feeding rear tool slide is mounted a vertical type tungsten-car-



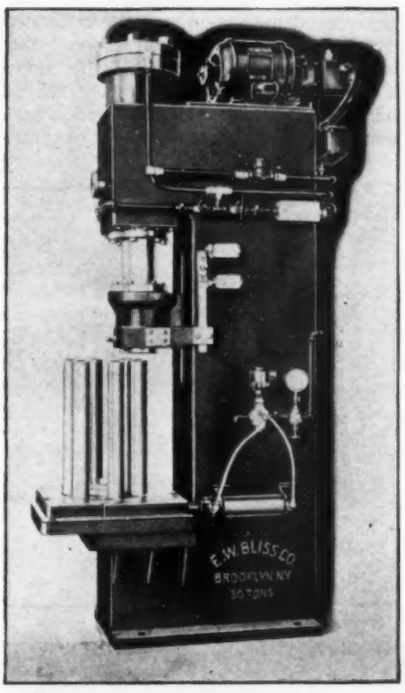
This special tool set-up on the Sundstrand Model 10 automatic lathe turns 18 of the 3-in. AA shell per hour



Copper bands on four sizes of shell are machined with this tooling set-up on the Model 10 automatic lathe

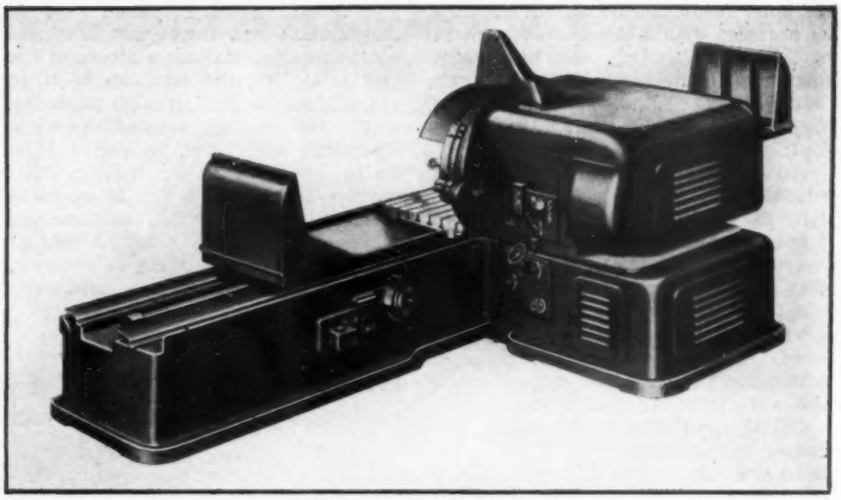
bide tipped form tool which finish-forms and grooves the band. Attached to the form tool is a high speed steel corner break tool. The 5-in. shell has an angular undercut in the band. To machine this undercut, an angular third or overhead slide is mounted on the headstock.

Production, with speed of 400 ft. per min. and feed of 0.016 in., is 75 of the 105-mm. shell, 28 of the 155-mm. shell, or 37 of the 5-in. shell per hour, at an efficiency of 85 per cent.



Bliss Hydraulic Marking Press Has Pneumatic Dial Feed

A high speed hydraulic marking press equipped with a dial feed and many safety features and automatic devices has been announced by the E. W. Bliss Co., 53rd St. and 2nd Ave., Brooklyn, N. Y. The press is of 30 tons capacity with 12-in. stroke. The six-station dial feed is pneumatically operated in sequence with the press stroke so that continuous operation and productions up to 20 cases per min. can be obtained. The drive is through a 5-hp. motor. Sequence of operation is electrically controlled with interlocks so that the press ram cannot descend until the dial is properly positioned; nor can the dial rotate until the press ram is in its raised position. Another safety feature of this press is the no-work control by which the press slide is prevented from descending if no work is placed on a given station. The dial is positively locked in position during the descent of the press. While the press is of 30 tons capacity, the pressure can be adjusted with accuracy to as low as 3 tons and the stroke can be adjusted as low as 1 in. if desired.



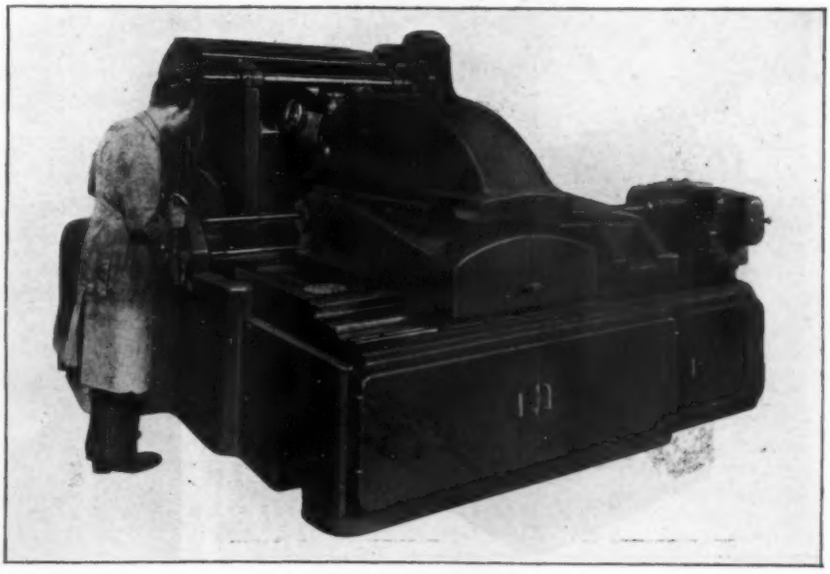
All Controls Centralized In New Diamond Face Grinder

Chief advantage claimed for a new face grinder, known as the "Philadelphia Type," announced by the Diamond Machine Co., Philadelphia, Pa., is increased speed of production. One of the features of the new machine is centralization of all controls. Every control lever, wheel, pushbutton and instrument dial or oil-filling point has been brought to one central location within easy reach of the operator. Bed has been lengthened so that at extreme limits of travel the platen never overhangs. Ways are wider apart, assuring more rigid foundation for the table. The platen has also been widened to allow for mounting a magnetic chuck or for grinding wider parts.

The table is driven by pistons mounted in double opposed cylinders, the rods of which are always in tension. The main spindle is driven by V-belts. The wheel head can be rotated horizontally as much as 15 deg. for concave grinding. There are two sizes of grinders: 30 in. and 36 in., corresponding to the diameter of the grinding wheel. In both sizes the sectional abrasive blocks are chucked firmly against a solid rim. Coolant is directed against the grinding wheel by an improved nozzle, eliminating clumsy hoses formerly used.

Red Ring Gear Shaving Machine Finishes 36-In. Gears

Red Ring gear shaving machine just announced by the National Broach Machine Co., 11457 Shoemaker St., Detroit, Mich., shaves gears up to 36 in. in diameter, 2-in. pitch and with face widths up to 36 in. Contrary to general practice in shaving smaller gears, the cutting tool of this machine is driven by the work gear. This eliminates high driving torque which might otherwise result. As in other Red Ring gear shaving machines, the cutter head



is built for crossed-axes setting and is provided with a sine bar adjustment so that any setting can be quickly duplicated. Reciprocation of cutter, and work gear spindle speed are varied by changing pick-off gears in the work-head drive.

An important feature of this new machine is its ability to develop the elliptoid tooth form so effective in eliminating gear failures caused by end bearing of gear teeth in operation. The amount of crown on the teeth of elliptoid gears can be varied by a graduated adjustment in the slidable head. As the cutter is reciprocated across the face of the work gear tooth, the work is automatically rocked.

Cutter head slide is adjustable for center distances up to 50 in. The head itself accommodates cutting tools of 7, 9 and 12-in. dia. The machine can be operated either automatically or manually as desired. Ways are hardened and ground. All sliding elements are force-feed lubricated. Splash plate is opened and closed by a motor controlled by pushbutton.

Versatility a Feature Of Hunter Vertical Slotter

Designed for die shops, toolroom and general repair shop operation, a new variable speed vertical slotter has been introduced by Hunter Engineering Co., Riverside, Calif. A number of features make it adaptable to a wide variety of machining operations. The work table is provided with longitudinal T-slots and is adjustable by hand feed in longitudinal and transverse directions and vertically. Maximum stroke of the ram is 4½ in.; the ram can be tilted either right or left through a 10-deg. angle for cutting tapered keyways. Operating speed can be varied from 90 to 180 strokes per minute. The positive-acting clutch can be operated from either side of the machine and makes it possible to stop the ram at any point. The machine is compact, being only 63⅜ x 38 x 48 in. in dimensions.

Lee Tool and Cutter Grinder Usable as Production Tool

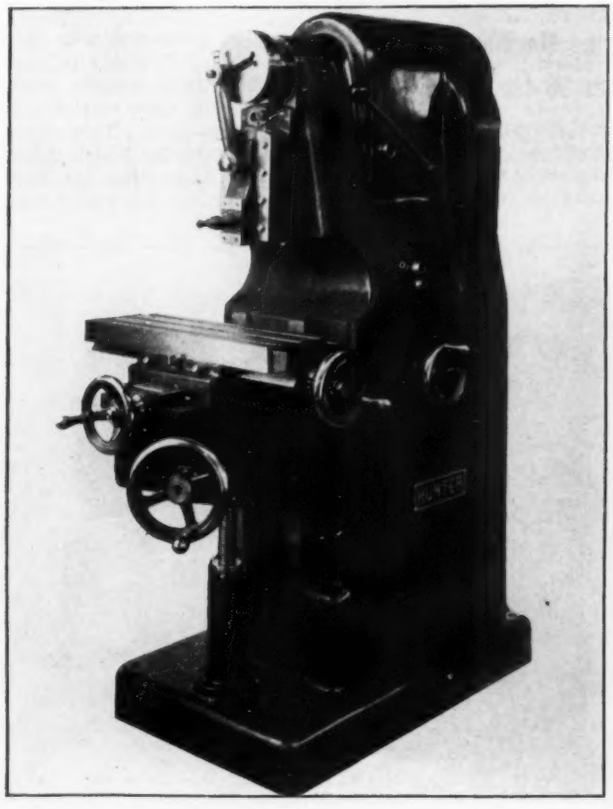
Designed especially for sharpening straight, spiral or angular milling cutters and face or form milling cutters up to 6½ in. dia.; straight taper, spiral or helical reamers; and slitting saws up to 24 in. dia.; the Model A600 tool and cutter grinder built by K. O. Lee Co., Aberdeen, So. Dak., is also finding considerable use as a production machine.

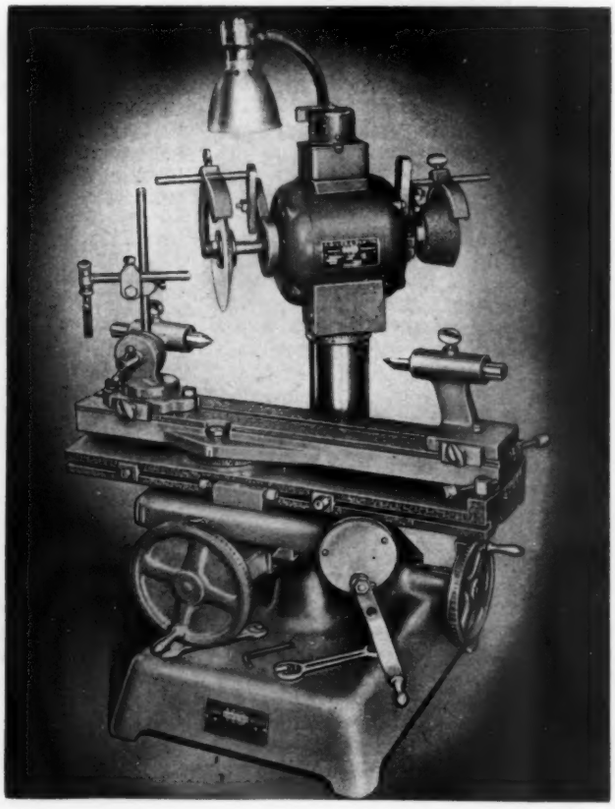
The two handwheels which raise or lower the motor head and the two clamps which lock it in place permit the operator to stand at either side of the grinder, adjust the motor head to the proper elevation, lock it by means of the nearest clamp and proceed with his work. The electrical connection panel is an improvement over the long cord furnished with earlier models. Drum type reversing switch permits rotation of wheels in either direction.

The grinder takes 16 in. between centers and swings 6¼ in. over table and 8¼ in. when the special V raising blocks are used. Longitudinal table movement is 11 in., cross feed is 3½ in., vertical feed is 7 in. Motor is ¼ hp., 3,450 r.p.m., single-phase, 110 volt a.c., equipped with ball bearings.

Sheldon 11-In. and 12-In. Lathes Have 1-In. Collet Capacity

The Sheldon Machine Co., Inc., 1624 N. Kilbourn Ave., Chicago, Ill., has announced new 11-in. and 12-in. lathes with pre-loaded ball or precision roller bearing headstocks. These lathes have a 1-in. capacity spindle hole which has 1⅜ in. diameter. Both bench and floor types with semi-quick or full-





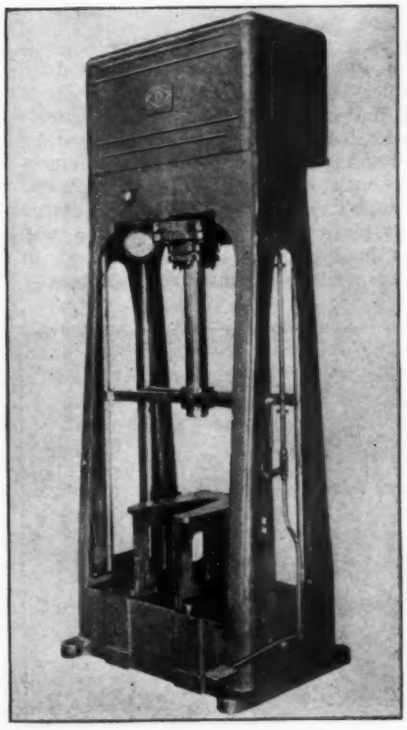
quick change gear boxes are available. A choice of plain aprons or worm feed aprons with power cross feed, and a choice of motor drives including the Sheldon needle bearing overhead motor drive and the Sheldon 4-speed lever-operated motor drive which is entirely inclosed in a cabinet leg, are offered. A complete line of attachments and accessories has been developed for these new lathes.

Diamond 40 Hydraulic Press Features General Utility

A new press known as the "Diamond 40," which can be used for assembling, broaching, straightening, riveting, forcing and pressing operations, has been introduced by the Diamond Machine Co., Philadelphia, Pa. The precision-machined steel ram of the press is guided, steadied and prevented from rotating for the full length of its travel by a cross-head riding on four rigid tension rods. Relief valves in the oil circuit protect against overloading the press with work. The electric motor is also protected.

The press is powered by a high-pressure Hele-Shaw pump. All high-pressure piping is extra heavy seamless steel. Oil tank, electric motor and hydraulic pump with their controls are compactly grouped at the top of the press and covered by a streamlined, removable housing.

Total daylight is 4 ft. 6 in. without the vee table, 3 ft. 12 in. with the standard vee table. Diameter of the ram is 4 in., stroke 24 in., maximum tonnage 40 tons. The overall height of the press is 9 ft. 7¾ in., floor space required is 2 ft. 8 in. x 3 ft. 8 in.

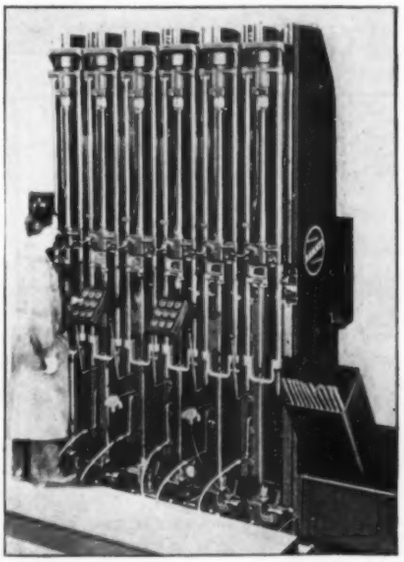


W. F. and John Barnes Co. Announces Two Machines For Drilling .30- or .50-Cal. Rifle Barrels

No. 410 rifle drilling machine also handles general deep-hole drilling jobs

A six-spindle vertical drilling machine and a No. 410 two-spindle horizontal drilling machine have been designed by W. F. and John Barnes Co., Rockford, Ill., especially for drilling rifle barrels. The six-spindle vertical drilling machine handles either .30-cal. or .50-cal. barrels with a maximum length of 45½ in. and a maximum diameter of 1¾ in. Each of the six spindles is provided with individual hydraulic actuation. Each has automatically actuated three-jaw self centering chuck for holding barrel, and each is individually driven by cartridge-type motors through V-belts. The revolving barrels are fed down over stationary single-lip drills. Each spindle is provided with individual coolant pump and filtering system. For convenience in tool changing, the tool holder is mounted on a slide to accommodate different lengths of drills, and manually swings out of position so that the drill can be withdrawn or placed in the holder. Each tool holder has an electrically interlocked torque overload protector coupled with hydraulic system.

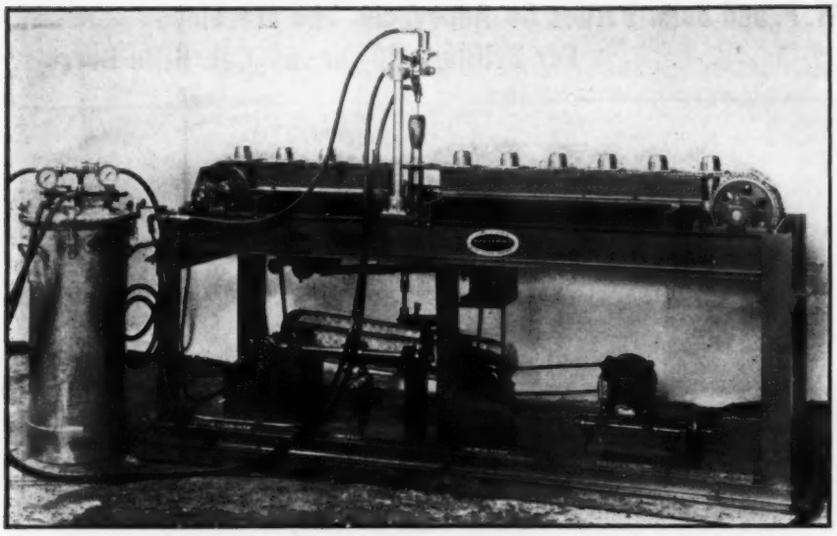
Although designed primarily for rifle barrel drilling, the two-spindle No. 410 machine is also suited to horizontal deep hole drilling of any parts which are diametrically balanced. Hydraulic actuation, supplied from a self-contained unit, imparts positive feed to the barrels. Drills feed through the last fraction of cuts, instead of breaking through. The two-spindle, hydraulically actuated headstock is mounted on 10-in. ways. Each spindle is driven directly through V-belts by motor mounted on top of unit. Since thorough coolant filtration is of great importance in a rifle driller, two filters and a storage settling tank are provided in the coolant system of this machine. The capacity of the machine is .50-cal. maximum. Available with strokes of 24, 36 and 48 in.



Each of six spindles of this vertical rifle driller operates individually

Eclipse Automatic Spray Gun Coats Inside of Shell

Automatic spray equipment to handle coating of insides of trench mortar shell or other objects having a conical interior has been announced by the Eclipse Air Brush Co., 400 Park Ave., Newark, N. J. The machine is entirely

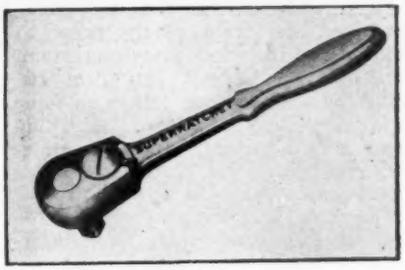


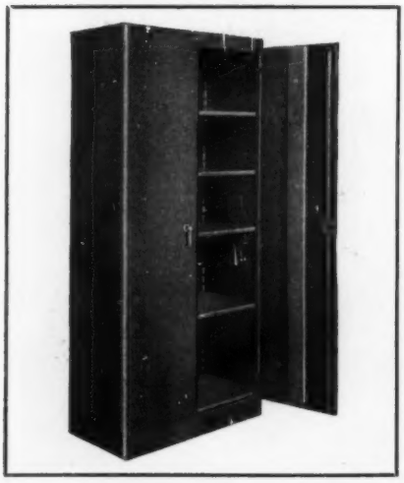
automatic, except that the shell are put on and removed manually. The shell is placed in a holder on a chain belt; it is carried along until it comes up to an automatic spray gun where it is elevated on a special device that spins it as it fits over an extension nozzle attached to the spray gun.

The timing of the machine is so arranged that an even coating is obtained on the cone-like interior. The machine will not spray unless there is a shell in the holder. Rate of operation is 1,000 shells per hr., using only 15 lb. per sq.in. pressure on the material and 20 lb. per sq.in. on the air.

Midget Reversible Ratchets Added to Supersocket Line

A new Midget Pattern Reversible Ratchet Wrench has recently been added to the Supersocket line of the J. H. Williams & Co., 225 Lafayette St., New York, N. Y. This tool, which has a ¼-in. square drive, is 4½ in. long. It incorporates the same patented double-tooth pawl for both on and off rotation as is used in other Williams Superratchet wrenches. A convenient shift lever at the head instantly reverses the wrench action. The handle is drop-forged from high tensile carbon steel; working parts are machined from chrome-molybdenum steel and are heat-treated. The wrench is finished with chrome-plate.





"Steelart" Metal Cabinets Feature Improved Appearance

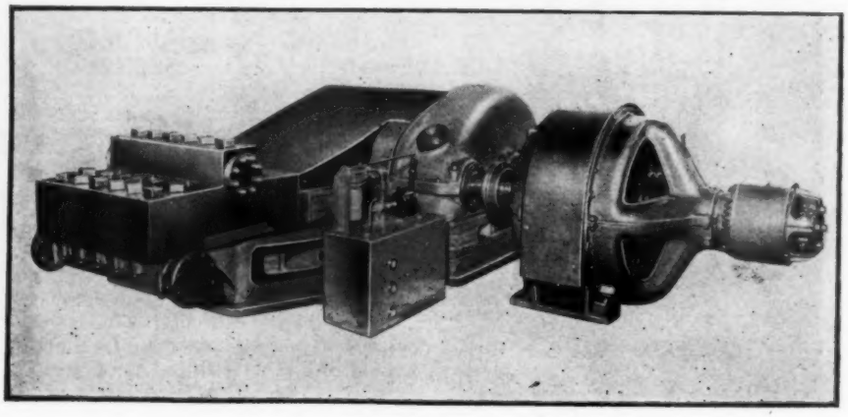
Round corner construction for improved appearance is an outstanding feature of the "Steelart" metal cabinets offered by Lyon Metal Products, Inc., Aurora, Ill. Included in this line are double-door and single-door storage, wardrobe and combination cabinets, and "Desk-hi," "Counter-hi," and janitors' cabinets.

Tubular frame construction and shelf reinforcements, coupled with rugged hardware, make for long life. All storage shelves are adjustable by hand every two inches. Standard finish is green. Finishes also available include white, walnut, oak, mahogany, brown and gray.

Baldwin Southwark High Pressure Pumps Designed for Hydraulic Press Installations

Designed to handle comparatively large volumes of water in conjunction with hydraulic press installations, a new line of high pressure pumps has been announced by Baldwin Southwark Div. of The Baldwin Locomotive Works, Philadelphia, Pa. The Horizontal Triplex pump has three pistons—an arrangement which provides a 60 deg. overlap in discharge impulses and tends to smooth out pump pulsations. Designed primarily for pressures in excess of 1,000 lb. per sq.in., the Horizontal Triplex Pumps are built with 12, 15 and 18 in. stroke lengths. They are designed for direct coupling to 125, 250 and 500 hp. motors respectively. The 12-in. stroke pump discharge ranges from 23 g.p.m. at 7,500 lb. per sq.in. to 160 g.p.m. at 1,000 lb. per sq.in. Other capacities and pressures are available.

Pump frame is a one-piece semi-steel casting. Cast integrally with the frame is the gear case, containing double helical single reduction gears. All rotating elements are carried in roller bearings, except the crank ends of the connecting rods which use steel-backed babbitt bearings lubricated by force feed. Valves are of Cramp Super-strength bronze; seats are stainless steel. The cylinder block is a large one-piece steel forging. Ground and polished plungers are freely held in crossheads to permit self-alignment.

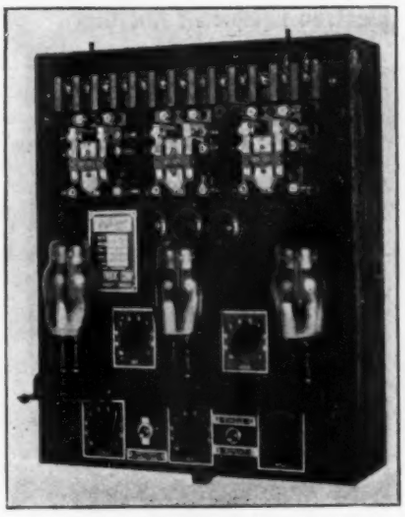


Weltronic Impulse Timers Simplify Welding of Heavy and Laminated Sections

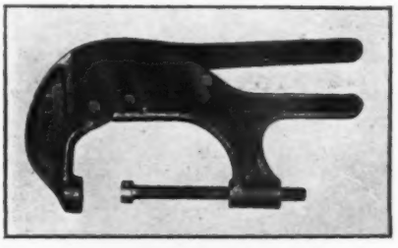
Where a single "shot" will not produce a consistently satisfactory resistance weld, a new line of electronic "impulse" timers is available from Weltronic Corporation, 3080 E. Outer Drive, Detroit. The line consists of a semi-automatic (Model No. 114) and a high speed automatic (Model No. 57) Weltronic timer. Both timers are adjustable for "on" time, "weld" time, "cool" time, and for the number of interruptions of current desired. The high speed automatic has in addition a dial for regulating the "off" time.

With these timers, welding operations heretofore extremely difficult can now be made with ease. This is particularly true for the welding of relatively heavy sections such as are found in structural work, automobile frames, truck cabs, blowers, and farm implements. They also simplify the welding of large numbers of laminated metal sections. For instance, as many as 15 or 20 pieces of 20-gage metal can be welded together at one time through the use of these timers.

The reason such welds are now possible is that the interruptions of current give the points a chance to cool off, while at the same time pressure



between the points squeezes the metal parts together to form a better contact and more perfect weld. The timers are useful also in welding sections having a coating of oxide or scale, since one "shot" can be used to blow out the scale, reserving actual welding for subsequent shots.



Klampacto C-Clamp Applies One-Ton Holding Pressure

Designed for use in the erecting shed, shipyard, round-house or machine shop, the improved "Klampacto" C-clamp announced by Knu-Vise, Inc., 16841 Hamilton Ave., Detroit, Mich., combines the deep throat of the standard clamp with the tremendous holding pressure of a toggle movement. The lower jaw swings clear of the work when released. It is unnecessary to hang onto both the clamp and work when fixing it into position, for a squeeze of the hand on the two handles applies it with 2,000 lb. clamping pressure. It is furnished with threaded spindle and lock nut, or with the patented Kam-Lock adjusting rod for use when arc welding to avoid spatter on the screw threads. The Klampacto C-clamp comes in three models with 5-in., 6-in., and 10-in. jaws. Clamp is hardened and tempered with enamel finish.

Pines Burring Machine Does Three Operations at Once

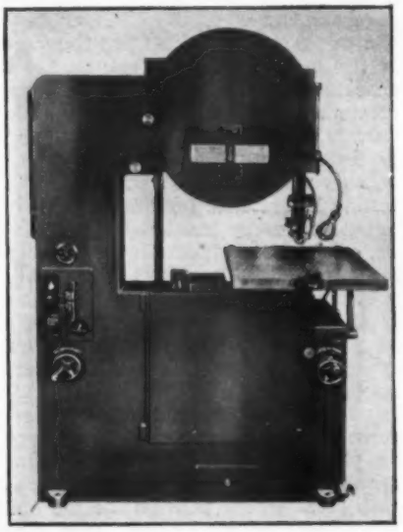
The Pines Engineering Company, St. Charles, Ill., announces a horizontal spindle burring machine for performing reaming, burring, facing, threading or honing operations on the ends of tubing and rods. This horizontal spindle machine features an air-operated work chuck controlled by a limit switch

which is tied in with the feed movement lever that advances the spindle. This mechanical-electrical arrangement gives production speeds up to 1,200 pieces per hr. on some classes of work.

Pictured is a typical production set-up where three operations are performed in a single pass: tube outside diameter is burred, end is faced and inside diameter is reamed. Tubes of any practical length and diameter can be handled. Different tools, readily interchangeable, are required for different diameters. Simplicity of set-up, flexibility and ease of operation, and adjustability for handling a wide range of tube and rod sizes are added advantages claimed by the maker.

Larger Tannewitz "Di-Saw" Designed With 30-In. Throat

Built along the lines of the standard No. 24-M model, this "Di-Saw" built by the Tannewitz Works, Grand Rapids, Mich., is provided with a 30-in. throat for handling considerably larger work. Similar machines having



throat capacities up to 48 in. can also be supplied for special purposes.

The machine is claimed to be satisfactory for cutting shoes, dies, templets, and for filing, polishing and other operations which are practicable with continuous motion machines.

George Scherr Tool Chest Keeps Machinists' Tools in Order

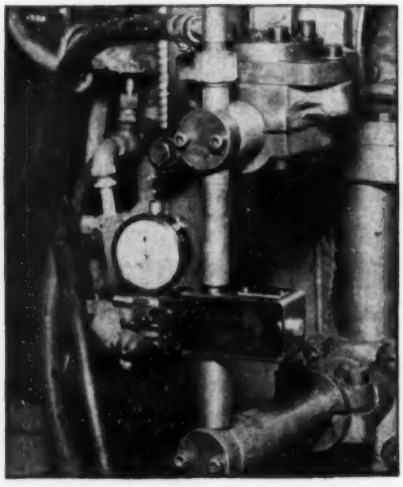
Drawers of a new line of tool chests supplied by George Scherr & Co., 128 Lafayette St., New York, N. Y., are properly designed to keep machinists' tools separated according to type and size, and to protect the tools from damage. For added safety and convenience the tool chests are provided with two locks instead of the one found on ordinary chests. Thus the open top

can be locked separately from the drawers. The chests are available in three sizes, and are produced in a specialized woodworking shop of solid oak with natural finish, leatherette covered, or of low-priced poplar.

G. E. Gage Checks Pressure Between Welding Electrodes

The pressure between the electrodes of resistance-welding machines can be measured by an electrode pressure gage announced by the General Electric Co., Schenectady, N. Y. The gage is for use either as a standard for checking existing gages or pressure indicators on spot, line, or projection welders, or for checking the electrode pressure before proceeding with production work. It also can be used by testing laboratories for pressure determinations, or by industrials interested in checking the pressure of various kinds of springs in compression.

The new gage measures pressures from 0 to 4,500 lb. Consisting simply of a calibrated steel yoke and a micrometer dial indicator, it is easily applicable to existing resistance welding machines. When electrode pressures are to be measured preliminary to production work, the gage is inserted between the electrodes so that they press on the pads on the top and bottom of the gage yoke. The electrode pressure is adjusted until the desired pressure is registered on the gage dial. The gage is then withdrawn and the welding machine placed in operation.

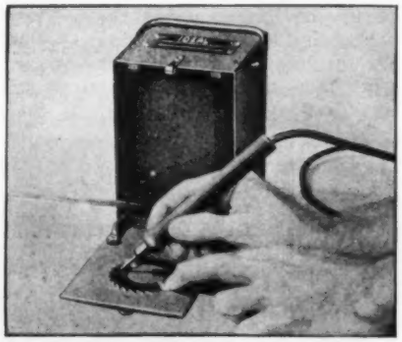


Electron Equipment Rectifier Has No Moving Parts

Direct current for operating adjustable-speed d.c. motors, magnetic chucks and signal systems is easily obtained with the industrial rectifiers offered by Electron Equipment Corp., Palm Springs, Calif. Claimed to operate at

high efficiency, these units are built in sizes from ¼ to 200 hp.

All parts are housed in a rugged ventilated steel case, finished in Duco. Operation and finish are said to be unaffected by temperature, moisture dust or vibration.



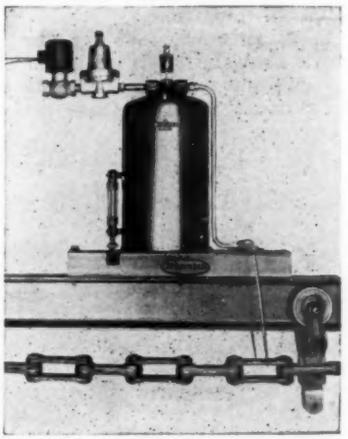
"Thin Line" Electric Etcher Marks Small Tools and Parts

Small, inexpensive "Thin Line" etcher announced by the Ideal Commutator Dresser Co., 1057 Park Avenue, Sycamore, Ill., permanently marks small tools and parts with a fine-line identification number or name burned right into the metal. It cannot become blurred or worn off with ordinary usage. All parts of the etcher are fully inclosed and out of the way when not in use. To mark tools, parts in production and finished products made of iron, steel and their alloys, they must be placed on work plate inside of cover. Etcher tool is then held and used as if writing with an ordinary lead pencil.

Complete unit includes 9-ft. primary lead and plug; 2-oz. heat resisting hand piece with 3-ft. lead; and 4x6 in. work plate, 115-volt, 50-60 cycle standard. Other voltages and frequencies are available. Etching heat is 125 watts.

Fauver Conveyor Lubricator Features Automatic Operation

To solve the problem of lubricating the chain links of conveyors passing through ovens, kilns and other hot zones, J. N. Fauver Co., 49 W. Hancock Ave., Detroit, Mich., offers an automatic conveyor chain lubricator. Lubricator consists of a 2-gal. tank hooked up with the plant air line, with an air regulator set at 80 lb. pressure to insure effective control and operation of the outfit. The air, passing through the lubricator, picks up a predetermined and adjustable amount of lubricant and delivers it, in the form of an oil fog,

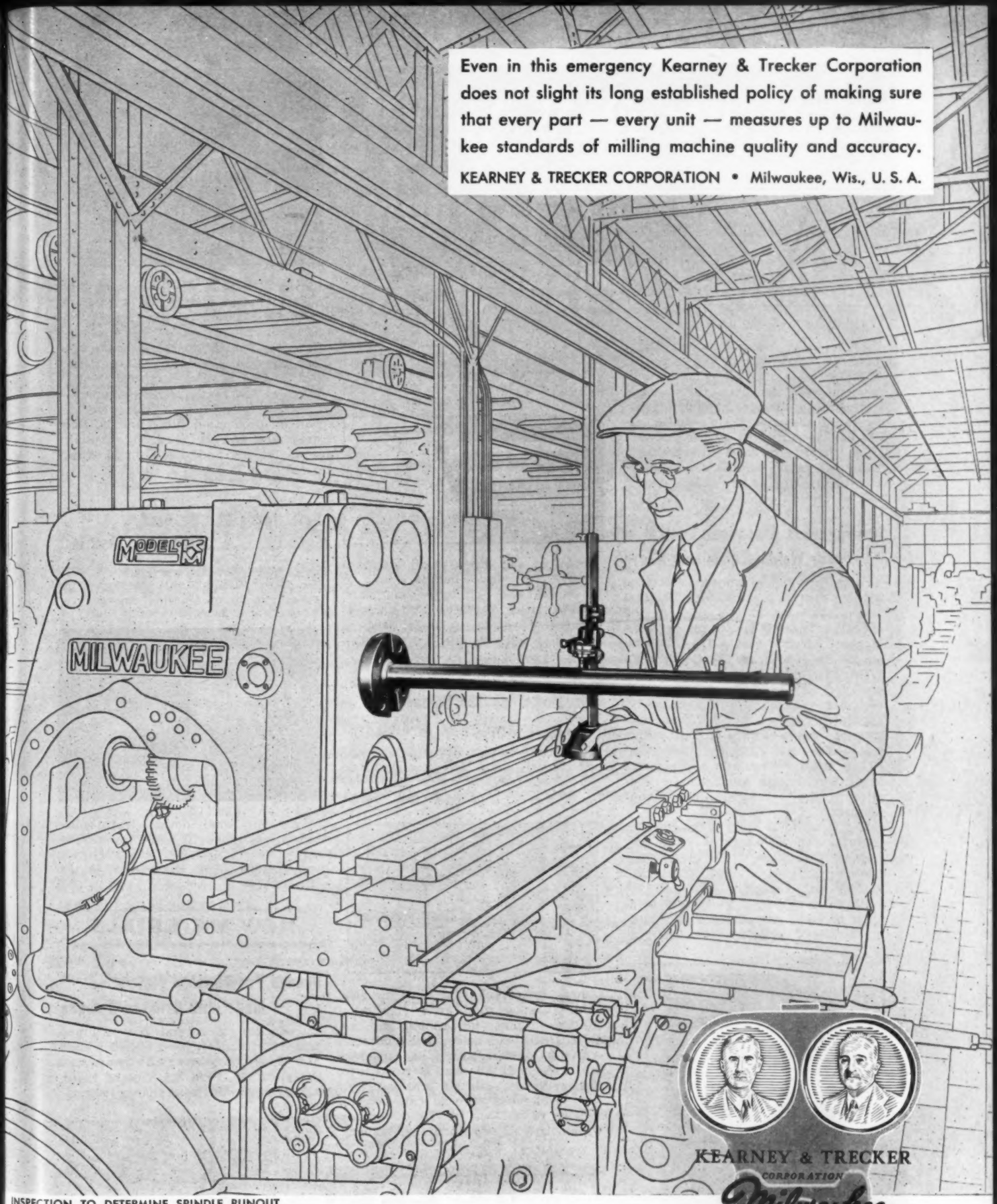


through copper lines to both sides of the chain links.

Colloidal graphite is used as the lubricating agent. The mixture and its application are so controlled as to insure each chain pin being lubricated for its entire length every trip and still leave no excess to cause drip. The spray of lubricant is easily adjusted to conform with chain speed. Action is entirely automatic. An electric solenoid valve on the lubricator inlet line is wired to the starting switches of the chain drive motors so that the lubricator starts operating the minute the conveyor starts and operates continuously thereafter.

Union Metal Pallet Designed For Freight Handling

Particularly designed for freight handling between customer and consumer, an improved all-steel, light weight single face pallet announced by the



Even in this emergency Kearney & Trecker Corporation does not slight its long established policy of making sure that every part — every unit — measures up to Milwaukee standards of milling machine quality and accuracy.

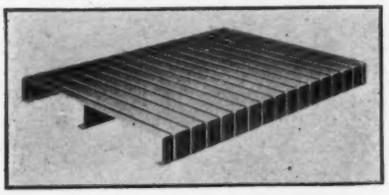
KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.

INSPECTION TO DETERMINE SPINDLE RUNOUT.

KEARNEY & TRECKER CORPORATION
Milwaukee
MILLING MACHINES

Milwaukee MILLING MACHINES

Union Metal Mfg. Co., Canton, Ohio, can be returned with low freight costs as compared with the cost of a new wood pallet. The top deck and legs are formed in one piece, and the number of channel spacer supports depends



upon width and load. Legs and spacers are provided with bottom flange adding further strength and serving as a floor protector. The gage of metal used in the pallet depends upon the strength requirements; likewise customer's needs determine the size. Double-faced pallets can be furnished by the addition of a slatted or solid bottom deck. These pallets are suitable for handling with hand pallet or power fork trucks.

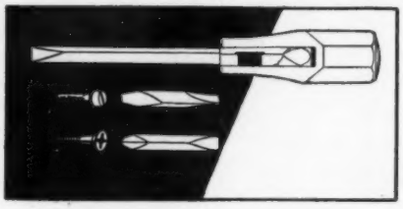
Westinghouse Announces Control For Welding Aluminum Alloys

A new capacitor discharge resistance welding control for welding aluminum and alloys such as are used in the aircraft industry is announced by Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. Known as the Condens-O-Weld, this unit is a complete control designed to include in one floor-mounted cabinet all the necessary apparatus required to control an electrostatic energy storage type of welder. Accessories not included are foot switch, pressure regulator and pressure gage; these items are normally supplied by the welding machine manufacturer.

The Condens-O-Weld is designed for operation on 230/460 volts ± 10 percent, 3 phase, 50 or 60 cycles. The charging circuit and its control charges a 2,640 mf. capacitor bank to 3,000 volts. Spot welding speeds of 40 to 80 spots per min. are obtained depending on the size of capacitor bank. Charging the capacitor may be taking place during the entire time interval between successive welds, thus reducing the power demand to a minimum. When used with certain welding machines, line kva. demands as low as 1/10 of that taken by a typical single-phase a.c. aluminum welder are possible.

"Fitzem" Screw Driver Fits All Screw Types

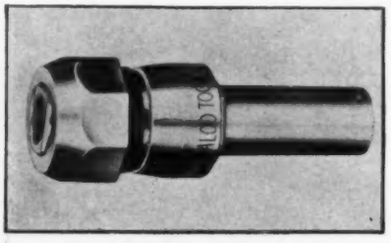
Both regular and Phillips recessed-head screws can be driven successfully with the "Fitzem" screw driver offered by Servwell Products Co., 6523 Euclid Ave., Cleveland, Ohio. This tool employs a square-shafted blade which is machined at one end to fit Phillips



screws, at the other to fit standard screws. The plastic handle is said to be unbreakable and to be unaffected by oil, water or grease. The blade is inserted into a square metal bushing molded into the handle and is held in place by a spring.

Releasing-Type Tap Holder Announced by Alco Tool

The Alco Tool Co., Bridgeport, Conn., has recently gone into production on a new releasing-type tap holder for hand screw machines and turret



lathes. Important features of the new holder are: a rigid drive eliminates the use of pins; no bushings are required; each tap holder will hold several sizes of taps within its capacity; one wrench is all that is needed to tighten the nut to hold taps securely; and right-hand threads can be cut equally as well as left-hand threads without any adjustment in the holders.

Stand Broadens Applications Of H.&H. Multi-Purpose Tool

A stand into which the Senior Model Multi-Purpose Tool (described A.M. Vol. 84, p. 520) can be clamped is announced by H. & H. Research Co., 12540

12th St., Detroit, Mich. Clamped into position in the stand, the Multi-Purpose Tool simplifies filing work on parts which are lighter than the tool. Necessity for clamping each workpiece is eliminated; the work instead of the tool is held in the hand. The Multi-Purpose Tool with reciprocating motion is designed for continuous operation on production filing and burring work and can be used to eliminate slow, tedious and costly hand filing operations.

Both Hands Can Be Used With "Rex Ristlite"

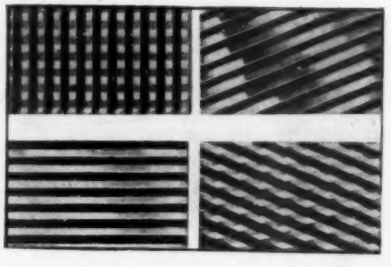
Both hands are left free for work with the "Rex Ristlite" unit developed by Flashlight Co. of America, Jersey City,

N. J. This small device straps comfortably to the wrist and throws light exactly where needed. It utilizes two standard flashlight batteries.

NEW MATERIALS

Bonded Pre-Finished Metals Made With Crimped Designs

Introduction of several new crimped designs in bonded pre-finished metals has been announced by American Nickeloid Co., Peru, Ill. One of these, a 7/16-in. crimp, is available in hori-



Save WEEKS of Delivery Time on Many of Your CARBOLOY TOOL REQUIREMENTS

. . . and also reduce your tool cost!

Vital Facts About Carboloy STANDARD STOCK Tools & Tips!

Here are three ways in which you can obtain your Carboloy tool requirements in the fastest, most efficient and most economical way under present conditions:

1 ***Use Carboloy Standard Stock Tools.*** **These are made in "mass production" quantities and are stocked and shipped by the thousands each week. You always get them faster than "specials". A check-up of your Carboloy tool needs will reveal many that can be easily changed over to standards. You save weeks of delivery time.**

2 ***Use Carboloy Standard Blanks.*** **These, too, are made in "mass production" quantities. If a thorough check reveals that you can't use Carboloy Standard tools (most users find they can), ask your tool designers to incorporate Carboloy Standard Blanks in their special tools whenever possible. This saves production time.**

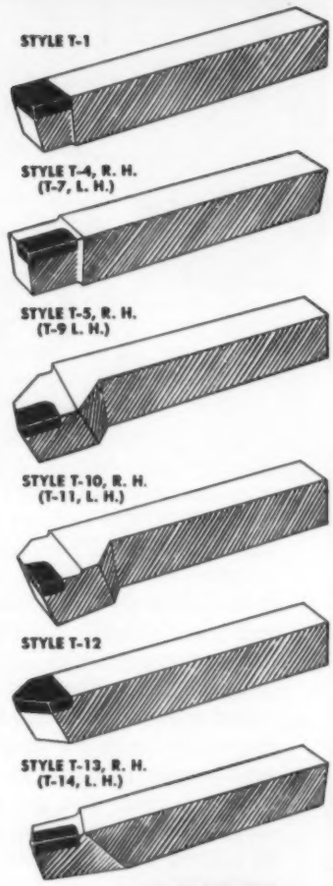
3 ***For emergency tooling braze your own Carboloy tools.*** **Many users keep a supply of Carboloy Standard Blanks ready for emergency tooling and repairs. Many, too, braze ALL their own Carboloy tools.**

Carboloy Standard Tools consist of the 10 styles shown at right, suitable for, or adaptable to, 60% to 80% of all turning, facing, boring applications. In cases where these tools, as supplied, do not exactly meet design requirements, you will find your tool room can usually grind variations to meet a wide range of special angles and shapes.

Generously sized Carboloy tips, plus modern rapid Carboloy grinding technique, make this procedure practical and fast. By this method you can take advantage of the greater economy and faster delivery of Carboloy Standard Tools—often WEEKS faster than "specials"!

Carboloy Standard Blanks, too, save time and money. Two styles (shown lower right) available in 65 sizes, three grades.

A few minutes spent to get the facts about Carboloy Standard Stock Tools and Blanks may save you weeks of delivery time. Send for Catalog GT-129.



Standard Blanks in 65 Sizes 2 Styles, 3 Grades

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Canadian Distributor: Canadian General Electric Co., Ltd., Toronto, Canada

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"You ALWAYS Get Standards FASTER Than 'Specials'"

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GET A HEAD START ON

Motor Control

WITH THE...

G-E COMBINATION STARTER

Via GraybaR

Proper starting control is step No. 1 in the direction of maximum motor dependability and plant safety. The *General Electric* CR7008 Combination Starter gives your motors a head start toward peak performance and your plant a head start toward full protection.

These convenient self-contained units combine a fusible manual circuit switch and magnetic starter in a single well-protected case. You get extra safety, because the cover can't be opened while the motor circuit is *ON* and power is applied to exposed parts. Wiring is speeded up, mounting is simplified, and the installation is neater. Available in a full range of types and sizes.

When you go to GRAYBAR for these starters, you get other "extras" as well. (1) Frank, competent assistance in choosing the type best suited to your needs by men who know your "overall" electrical picture. (2) Delivery of standard items from nearby stocks in every important industrial center. (3) "One-call" service that brings you motors, controls, wire, conduit and all necessary accessories that will go together on the job.

For motor installations that are out in front right from the start, put all your needs up to GRAYBAR.

Bulletin GES-2599 shows cost-saving installations in over 25 plants. It's yours for the asking. Write GRAYBAR *for your copy.*

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zontal, diagonal, square, and diamond patterns in a variety of metal thicknesses. Sheet size available in most patterns is up to 24x36 in.

A second design, termed an oval crimp, is introduced in two widths—⅛ and 3/16-in. in long, continuous coils, and in gages ranging from 0.10 to 0.15 in. Both crimps are offered in bright or satin finishes of nickel, brass, chromium, or copper electro-bonded to basic metals of steel, zinc, or brass.

The rounded contour of the oval crimp makes it adaptable for inlay purposes. The 7/16-in. crimp is offered for a variety of purposes including reflectors, stove pads, electrical appliances, display stands, signs, and any application that requires a new decorative treatment.

Acromark Ink
Marks Vinylite Plastics

An ink that can be furnished in any standard color, silver, gold, black, white, blue, red, and others, has been brought out by the Acromark Corp., 251-257 N. Broad St., Elizabeth, N. J., to meet the demands for a marking or printing ink that will successfully mark Vinylite. It is compounded in a paste form and is used as a regular printing ink. By spreading on a flat plate or platen, it can be used with a rubber stamp or metal die. Color content penetrates the surface and adheres under rigid tests such as rubbing, weather tests, salt-water tests, and all natural conditions. Can be applied during or after fabrication.

U. S. Rubber Tire Compound
Has Low Rolling Resistance

Substantial power savings in industrial trucks are made possible through the low rolling resistance of a new rubber compound for industrial tires announced by the United States Rubber Co., 1230 Sixth Ave., New York, N. Y. At the same time, the company says, no sacrifice has been made in the long wearing qualities of the tire. Performances of tire compounds have in the past varied widely with individual operations. On some jobs a tire would be chosen because of its ability to stand hard abuse. On another, tires with low rolling resistance are needed for more economical truck operation. Another type of service requires a tire with low internal heating generation capable of operating at sustained speeds.

Tests have shown that electric trucks will operate at speeds up to 1½ m.p.h. faster on the new compound than on standard compounds used on the same truck, at the same time reflecting a savings in battery consumption up to 30 percent. The result is lower cost per ton mile. Known as General Purpose Compound, the new product will replace the company's former General Purpose and Rapid Transit Compounds and will be furnished on future industrial orders when specified.

Durez Plastic Coating Makes Castings Less Porous

By impregnating porous castings with a phenolic resin designated 7347-A, castings which do not quite hold specified pressures, due to factors beyond the control of the manufacturer, can now be made entirely satisfactory. In the process, announced by Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y., the impregnation is accomplished by forcing the resin into the pores of the casting under air pressure. In the case of small castings, this may be done in a suitable pressure tank. Larger castings can be sealed and the resin pumped directly into the casting. Pressures between 45 and 100 lb. per sq. in. should be used.

After the resin has been forced into the casting under pressure, baking is necessary to thoroughly set or polymerize the resin. Small castings are baked in an oven for several hours at 250 to 275 deg. F., or preferably in a pressure tank by applying steam at 20 lb. per sq. in. for two hours followed by 100 lb. per sq. in. for two hours. Baking under pressure produces a cleaner, smoother surface. The resin hardened in this way is practically impervious to water, solvents, mild alkalies and acids.

TRADE PUBLICATIONS

MOTORS Century Electric Co., St. Louis, Mo. has published a four-page leaflet which illustrates and describes the advantages of explosion proof motors.

OXY-ACETYLENE WELDING A 12-page illustrated booklet, No. 4694, "What the Purchasing Agent Should Know About Oxy-Acetylene Welding and Cutting Equipment and Processes," is being circulated by the Linde Air Products Co., a unit of the Union Carbide & Carbon Corp. The booklet is a guide to the selection of the proper type of equipment and contains a check list of important points to consider in selecting welding and cutting blow pipes, cutting machines, regulators, and acetylene generators.

SPOT WELDERS Thomson-Gibb Electric Welding Co., Lynn, Mass., is circulating a four-page leaflet which illustrates and describes the operation of spot welders.

STEEL GEARS John Waldron Corp., New Brunswick, N. J. has issued a four-page folder which lists prices and discounts of silent steel gears.

SWITCHES AND FUSE CUT OUTS Westinghouse Electric and Instrument Co., is circulating the following literature: A four-page leaflet, No. 38-620, which describes primary fuse cutouts for outdoor use on distribution trans-

"I WANT THE BEST POSSIBLE JOB— I MUST HAVE A GOOD OIL!!"

"THAT'S WHY I CALLED THE CITIES SERVICE LUBRICATION MAN IN" SAYS A. E. DAVEY, PRESIDENT OF ALLOY STEEL GEAR AND PINION COMPANY OF CHICAGO.

"I'm doing a job here that must be perfect when it leaves the shop. The people who get the gears are plenty critical." These are the words of A. E. Davey, president of the Alloy Steel Gear and Pinion Company.

A. E. Davey

He says further, "I don't know everything about oil. That is why I called in the Cities Service Lubrication man. I expect him to work with my men to see that they get the lubricant best suited for the job."

Much work in this shop must meet rigid government inspection. All machines, including Gleason, Fellows Gear Shapers, Lee Bradner and Browne & Sharpe machines, are operated with Cities Service Lubricants. You, too, will find these high-quality fluids capable of doing the kind of work your customers want.

Call us in for consultation—there is no charge for the service. Write us on your letterhead or mail the coupon for a copy of our booklet, 'Metal Cutting Lubrication.'

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Automatic in operation. Similar in principle to multiple tooling and combined cutting. Reveals "hidden profits" in your mass production grinding work. Employs new application of recognized mechanical principles to increase accuracy of wheel feed control. Standard Bowgage wheel heads mounted for special operations can easily be remounted for other work later. Keep your investment in special grinding equipment at a minimum by having Fitchburg grinding engineers study your blue prints.

This new booklet is free to executives writing on firm letterhead.

FITCHBURG
GRINDING MACHINE CORP.
1706 Falulah Road, Fitchburg, Mass., U. S. A.

former installations; a 24-page bulletin, No. B-2273, which describes switchgear for control stations and industrial plants; a four-page leaflet, No. 36-163, describing outdoor group-operated disconnecting switches for isolating oil circuit breakers and lightning arresters; a four-page leaflet, No. 18-320, describing a pin hole detector for showing up holes in sheet metal; and a four-page bulletin, No. DD-4063, which describes a.c. adjustable speed drives between 1 and 15 hp. for use over wide speed range.

TOOL STEEL The Carpenter Steel Co. is circulating a 96-page booklet which alphabetically thumb-indexes all parts of tools and dies in general use. The various conditions each part of die or tool may meet in fabrication, heat-treating and service are analyzed and specific tool steels recommended to meet each set of possible conditions.

TRANSFORMERS A 16-page booklet No. B-2266, describing SL transformers up to 10,000 kva. for use in industrial plants is being circulated by Westinghouse Electric & Mfg. Co.

TRANSMISSIONS A four-page catalog released by Western Manufacturing Co., Detroit, describes methods for motorizing cone driven machine tools.

TUBE STANDARDS A revised list of standard specifications, technical data card No. 107A, for seamless tubes and pipe is being circulated by the Babcock & Wilcox Tube Co., Beaver Falls, Pa.

NEW BOOKS

AIRCRAFT TUBING DATA — *Consulting editor, John E. Younger, University of Maryland. 135 pages. Published by Summerill Tubing Company, Bridgeport, Pa. $2.00 with ring binder and $1.50 with wire binder.*

Published to supply in a single volume the design data and related information useful to aircraft engineers and technical personnel, this loose-leaf volume is divided into four sections. In the first section is covered information on tubing, its manufacture, government specifications, tolerances, and special shapes. In other words, it deals with what the tubing mill can supply. Incorporated in this section is a discussion of the manufacture of seamless steel aircraft tubing prepared by A. G. Williamson, chief metallurgist, Summerill Tubing Company. Also included are a number of important charts of physical properties of various aircraft steels, together with a well illustrated discussion of the practical application of tapered tubes by L. E. Reisner, president, Tennessee Aircraft Institute.

In the second section, which deals with shop practices in the practical application of aircraft tubing, there is an article on oxy-acetylene welding of chromium-molybdenum steel tubing by H. R. Morrison of the Linde Air Products Company; a discussion of the arc welding of tubular aircraft structures by Frank B. Bolte, process engineer, Boeing Aircraft Corp.; a discussion of practical and theoretical procedure in the art of atomic-hydrogen welding by H. P. Reiber, Lycoming Division, Aviation Mfg. Corp.; an article on nondestructive inspection by H. T. Huester of the Bureau of Aeronautics; a discussion of corrosion protection by Charles W. Woodrow, chemical engineer, Naval Aircraft Factory; and a discussion of tube bending methods by H. M. Williams and C. G. A. Swanson of Williams, White & Company. All of these articles are fully illustrated, and give factual information on each of the processes described. This section will be of particular value to production and tool engineers connected with the aircraft industry, or with concerns doing sub-contracting work for that industry.

The 63 pages in the third section of this handbook are given over to tabulations and charts giving design data which is based on the requirements of the ANC-5 Handbook. Also included in this section is a discussion of the commonly used formulas involved in the application of tubing to aircraft structures.

Commonly used reference tables make up the ten pages of the fourth section. Included are tabulations of areas and circumferences of circles, the functions of numbers, and conversion tables for measurements, weights, volume and temperature.

In the preparation of this handbook, a number of men directly connected with the aircraft industry, the Civil Aeronautics Authority, the Air Corps and the Bureau of Aeronautics were consulted. It is a valuable contribution to the information available on the use of tubing, and should have applications in a number of industries not connected with the production of aircraft.

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THE AVIATION MECHANIC—*By Carl Norcross, assistant editor, Aviation, and James D. Quinn, Jr., Manhattan School of Aviation Trades, New York, N. Y. McGraw-Hill Book Company, 330 West 42 St., New York, N. Y. $3.50.*

Beginning with introductory material about the airplane, including definitions of terms, types of aircraft and aerodynamic principles involved in flight, the book takes up in order the construction of airplanes and airplane maintenance. One section of the book gives an unusually complete treatment of airplane construction, discussing materials and methods and describing every step in the manufacture of a light all-metal plane. Following is a description of how modern airplanes are built in larger factories.

The book contains a number of note-

worthy features: (1) Every phase of maintenance, from servicing the small private plane to servicing air transport and military equipment. (2) Sufficient material for student pilots who are taking the aircraft operation ground school course in the Civilian Pilot Training program of the Civil Aeronautics Board. (3) A wide variety of material on airplanes and engine inspection and servicing, which is presented to meet the qualification requirements of both private and commercial pilot's certificate of competency. (4) Photographs and drawings of all types of planes, tie in with the text to clarify descriptions of construction and maintenance.

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JIGS, TOOLS AND FIXTURES. *Second Edition—By Philip Gates. 209 pages. Published by the Chemical Publishing Co., 234 King St., Brooklyn, N. Y. $4.00.*

While designed primarily for the beginner, this volume includes material of interest to the tool designer and shop executive. The author was formerly lecturer in machine construction and drawing at the Aylesbury Technical School, England, and his presentation naturally follows English practice. Many of the cuts have been obtained from the pages of The Machinist (European Edition), and the London Edition of Machinery.

This new edition includes a chapter on materials because of their importance to the subject of tooling. Specialized subjects like plastic mold design and die-casting molds have been omitted.

•

SCIENTIFIC PRICE MANAGEMENT — *By Allen W. Rucker. Published by the Eddy-Rucker-Nichols Company, Cambridge, Mass. $5.00.*

With so much attention, governmental and otherwise, being given prices nowadays, a good guide to pricing problems is timely. Mr. Rucker's book is not so much a treatise on the theory of pricing as it is a practical working manual designed to afford a realistic approach to the subject. The author provides a means of determining required volume increases by providing six calculating charts. These are cellophane surfaced to give durability, while the volume is bound in hard covers with a plastic binding that permits it to open flat.

The charts enable those who make pricing decisions to determine without calculation just what added volume, for example, would be needed to offset a five percent advertising allowance. Other charts provide a ready means of solving similar problems. The book is planned especially for executives, sales managers, retail store buyers and merchandise managers, production managers, auditors and trade association officials who have decisions to make regarding prices.

NEEDLE BEARINGS

AID DESIGN AND reduce friction for

SPERRY GYRO-PILOT

THE SPERRY GYRO-PILOT has elevated navigation to a more exact science throughout the world. Low coefficient of friction is essential in its design, so Torrington Needle Bearings are used in important assemblies. They assure lasting anti-friction performance. And their small O. D. — no more than for a plain bushing—permits simplified design and smaller surrounding parts.

MAINTENANCE LUBRICATION IS PRACTICALLY ELIMINATED in the Gyro-Pilot's Servo Assembly by Torrington Needle Bearing's large grease retention capacity. Another advantage—Needle Bearing units are quickly and economically installed in the simplest type of housing. Initial costs are surprisingly low. They are used today in hundreds of important types of mechanisms.

If your product does not at present incorporate the advantages and economies of Torrington Needle Bearings—small size, light weight, high radial load capacity, ease of installation and minimum of lubrication and wear—consult our Engineering Department today. Write or wire for Catalog No. 105. For Needle Bearings to be used in heavier service, ask our associate, Bantam Bearings Corporation, South Bend, Indiana, for Booklet 103X.

1866 — 75 YEARS OF MANUFACTURING PRECISION PRODUCTS — 1941

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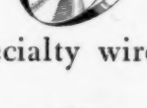
NEEDLE BEARING

NO VACATION *for him!*

No, although we are very busy—we are not too busy for research. No "blitzkrieg" of orders will be allowed to interfere with our efforts, through planned research, to constantly develop Roebling round, flat and specialty wires.

Today's demands are important—and must be met speedily. But what of tomorrow? Although Roebling plants are operating day and night—at full capacity—there will be no compromise with quality and no vacation for research!



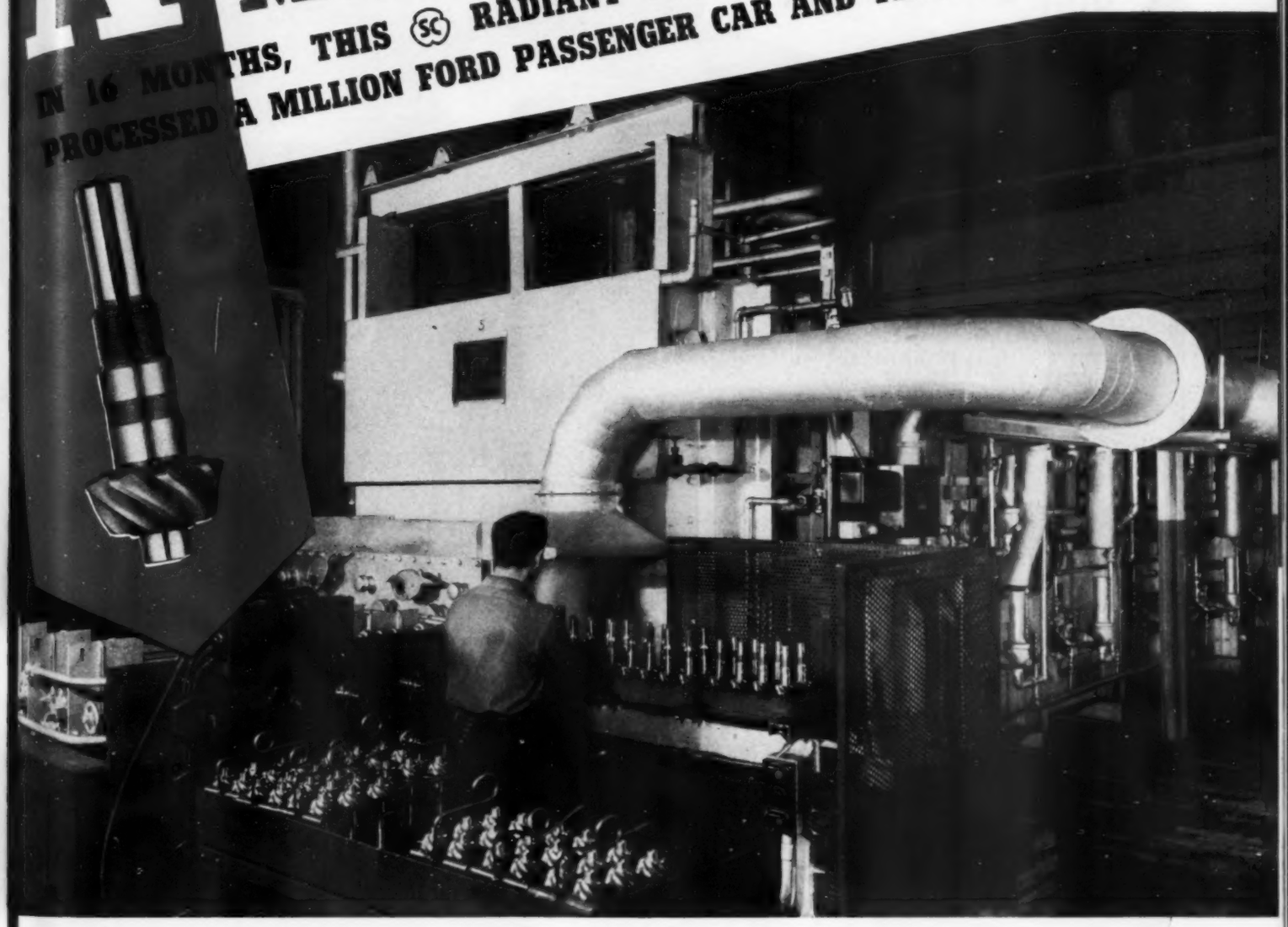
ROEBLING WIRES

ROUND · FLAT · SPECIALTY

JOHN A. ROEBLING'S SONS COMPANY · TRENTON, NEW JERSEY

A MILLION FORD PINIONS

IN 16 MONTHS, THIS (SC) RADIANT TUBE GAS CARBURIZING FURNACE PROCESSED A MILLION FORD PASSENGER CAR AND TRUCK DRIVE PINIONS



● For carburizing drive pinions, differential and transmission gears, five SC Radiant Tube Gas Carburizing Furnaces are now in operation at the Rouge Plant of the Ford Motor Car Company. To date (16 months) the first unit has processed more than one million drive pinion gears for both passenger cars and trucks.

The pinions are pushed through the furnaces on trays in four rows, each row having a separate pusher. Normally, three rows are used for passenger car pinions and the fourth row for heavier case truck pinions. The rated capacity of the furnace is 3000 passenger car pinions and 500 truck pinions per twenty-four hour day.

As the pinions come from the furnace they are clean enough not to require brushing. They are quenched exactly as they come from the furnace without brushing or cleaning.

Operation of SC Eutectrol Gas Carburizing Furnaces is very simple. No delicate or expensive instruments are required. All that is necessary is a periodic inspection of the atmosphere gas lines to see that they are clear.

While the use of radiant tube heating has made possible the construction of larger gas carburizing furnace than is practical with a muffle, there are many applications where the muffle-type furnace—of which there are more than sixty-five SC installations in operation—is still the most practical.

We shall be glad to have our engineers analyze your problem and make definite recommendations. Write **SURFACE COMBUSTION CORPORATION • TOLEDO, OHIO**

"SECURITY FOR AMERICA"

SURFACE COMBUSTION

MANUFACTURERS OF INDUSTRIAL FURNACES · JANITROL GAS-FIRED SPACE HEATING EQUIPMENT · AND KATHABAR AIR CONDITIONING SYSTEMS

Heavy ring being welded with Airco No. 81 Electrode using Wilson Hornet Arc Welder.
Photographs courtesy of Louisville Drying Machinery Company.

Accelerate production — speed up the welding of frames, tanks, pressure vessels, pipe and structural members with Airco No. 81 Electrode. This high-speed, mild steel electrode is designed especially for making single pass horizontal fillets on ¼" and heavier steel, and single or multiple pass flat positioned fillets. Highly satisfactory results are also obtained with Airco No. 81 when welding "V" or "U" grooved sections. The heavy slag of this shielded arc electrode affords ample protection, floats dirt and other foreign matter from the weld. Yet, after cooling, the slag is practically self-removing.

Weld deposits of Airco No. 81 Electrode exceed requirements of the specification for classification E 6020 filler metal by the A.W.S. and A.S.T.M. They regularly develop tensile strengths of 63,000 — 70,000 p.s.i. and elongations in 2 inches of 28% — 32%. Airco No. 81 Electrodes are readily available from any nearby Airco stockroom or distributor. So be sure to order a supply today.

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General Offices: 60 EAST 42nd ST., NEW YORK, N. Y.
DISTRICT OFFICES IN PRINCIPAL CITIES

AIRCO — WILSON

Anything and Everything for GAS WELDING or CUTTING and ARC WELDING

WHY Concentric Cable for Resistance Welding?

Because It's the Best for the Job

CONCENTRIC construction permits use of single cable—rather than two single-conductor cables—with resultant reduction in cable investment and greatly reduced voltage drop.

Exceptionally high-grade insulation—G.E.'s No. 1799 varnished-cambric—offers high dielectric strength, long life, and heat resistance. Protective finish can be either a flame- and weather-resisting braid or a lead sheath, depending upon your individual requirements.

Complete, detailed information on G-E cable for resistance welding is available in our new Bulletin GEA-3503. It contains useful data on how to select proper size of conductor, and a handy table of voltage drop for different ampere ratings. Useful to those who use resistance welding. Call your nearest G-E office or distributor. Or write to General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

501-4-1200 & 8748

Speed Control Convenience
WITHOUT LIMITATIONS

RELIANCE V*S DRIVE

AN ALL-ELECTRIC ADJUSTABLE-SPEED DRIVE
FOR A-C. CIRCUITS
Speed Ranges up to 16 to 1—Sizes 1 to 30 hp.

● These control elements make starting and stopping as easy as ringing a door bell; speed changing as simple as tuning your radio. *Mount them wherever you can run a wire.*

PICK THE SPOT where speed changing will be done most handily and *when needed.* You can put the speed changer for the Reliance V*S Drive right there, and the *start-stop* station alongside. There are no limitations whether machines are long or short, high or low, wide or narrow. Speed changer and *start-stop* station can be at any distance from the motor or speed-control unit. Put them any place that you can run a wire.

PRODUCTION AIDS

Other features which help boost production are: quick stopping, reversing, safe speeds for threading and inching, ample starting torque with controlled acceleration, and speed setting. *Get Bulletin 310 for details.*

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THE DIRECT WAY

Speed-changing devices, clutches, gear trains, a multiplicity of handles and knobs disappear when you apply this wide-range adjustable-speed drive. It makes full use of the electric motor, not only as a power unit, but also as a simple speed-changing device.

RELIANCE A-C D-C MOTORS

They also Serve
WHO CONSERVE

TUNGSTEN has become a strategically important material, in view of the huge demands of industrial and defense needs, which require High Speed and other tungsten steels in day-by-day increasing quantities.

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DBL, a development of Allegheny Ludlum research, is a 5½% Tungsten High Speed Steel, thus containing less than one-third as much tungsten as "18-4-1." In addition:

1. DBL equals or betters "18-4-1" in performance.
2. It heat-treats and handles in the same equipment and by the same methods as "18-4-1."
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4. It costs less and is lighter than "18-4-1;" the user secures more pounds of DBL per dollar, and more tools per pound.

• Under normal circumstances, being ourselves large producers of "18-4-1," we would have introduced DBL more gradually. *But these are not normal times.* To steel and tool manufacturers, therefore, we offer a royalty-free license to use DBL. To all users, complete technical data is available upon request for the "DBL Blue Sheet." Write Dept. T-127

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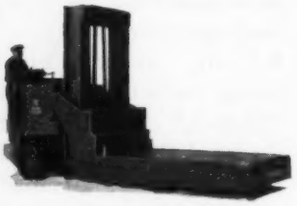

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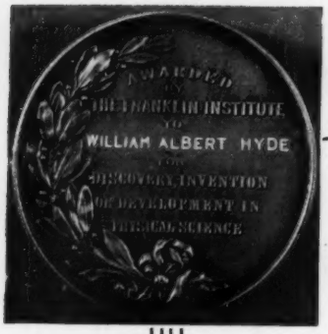

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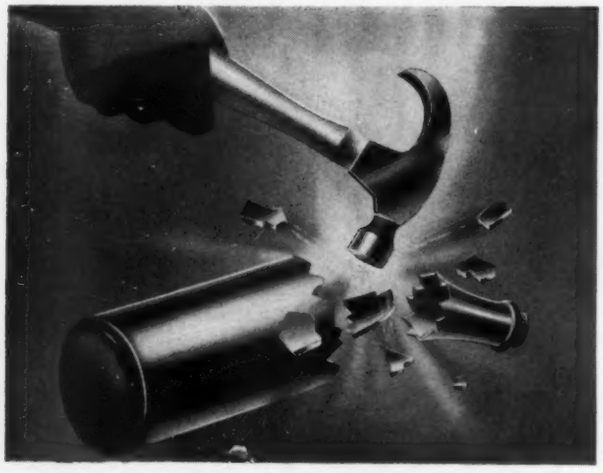

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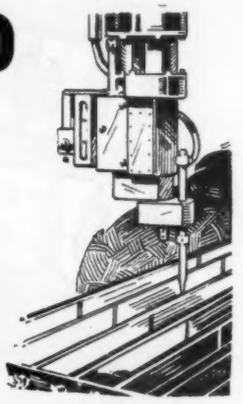

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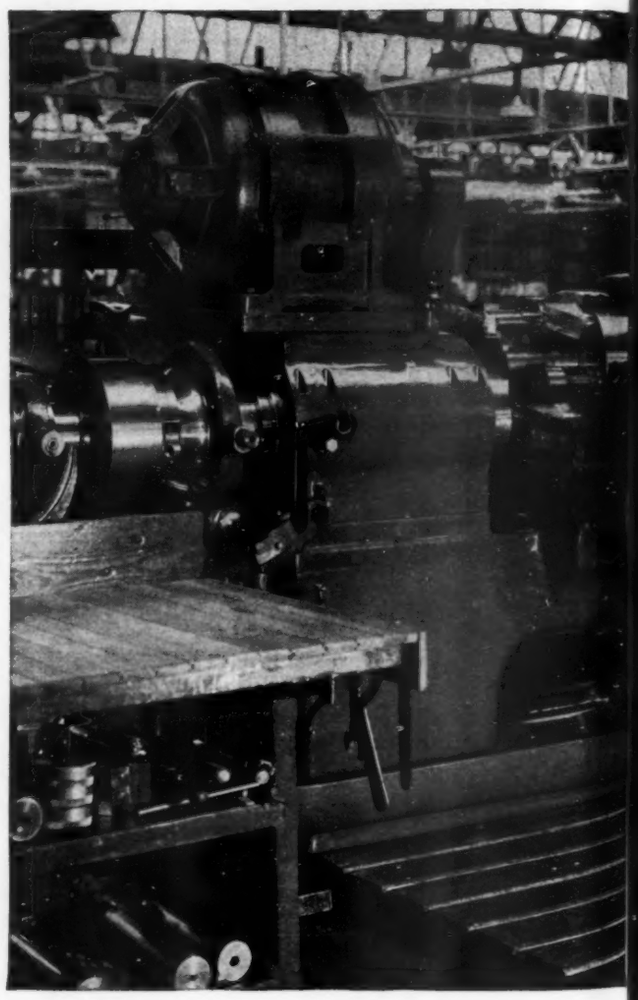

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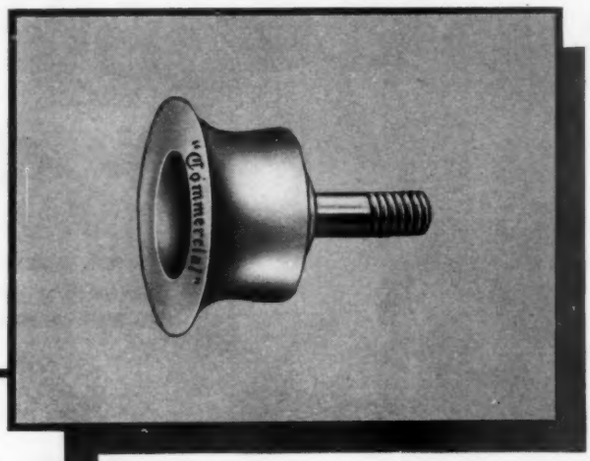

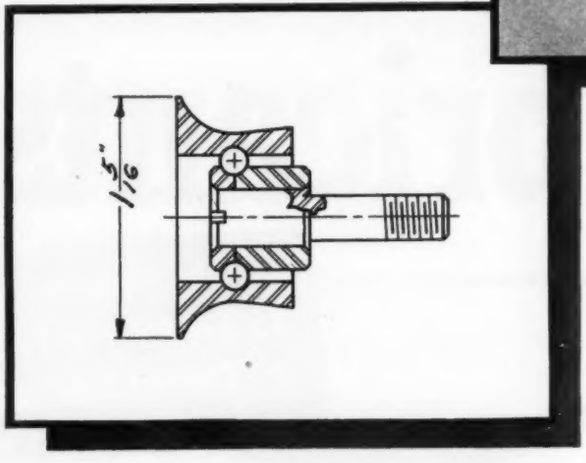

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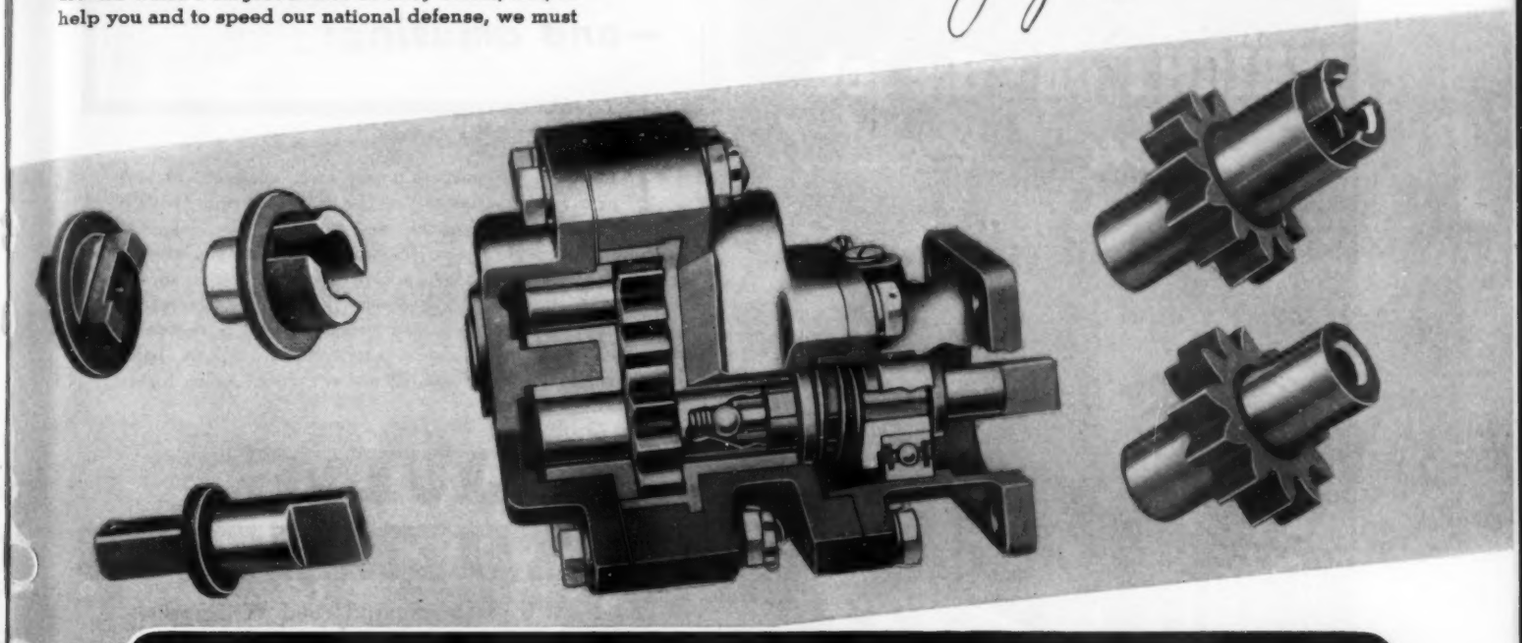
Through a simplification of your needs you can help yourself while helping us produce more and better *steel—first line of national defense.*

R. J. Wysor
PRESIDENT



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REPUBLIC *Alloy Steels*

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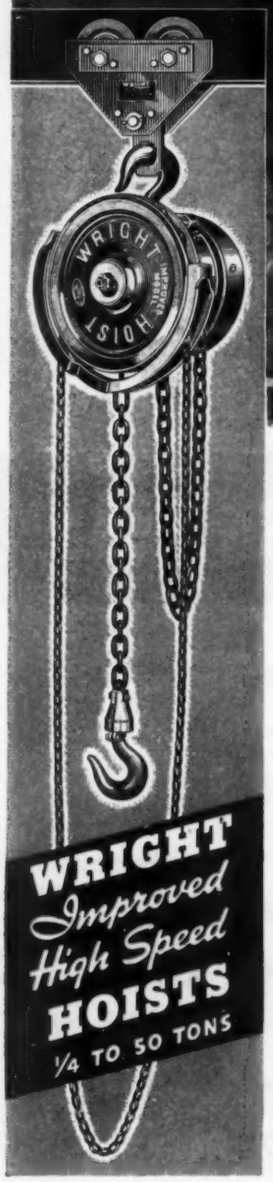

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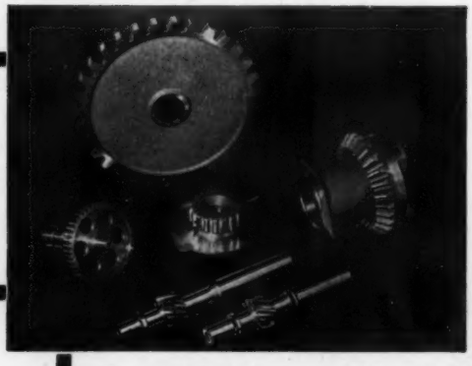

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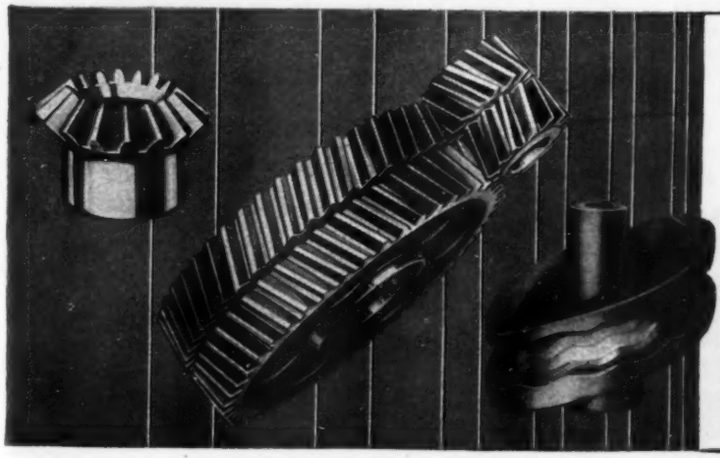

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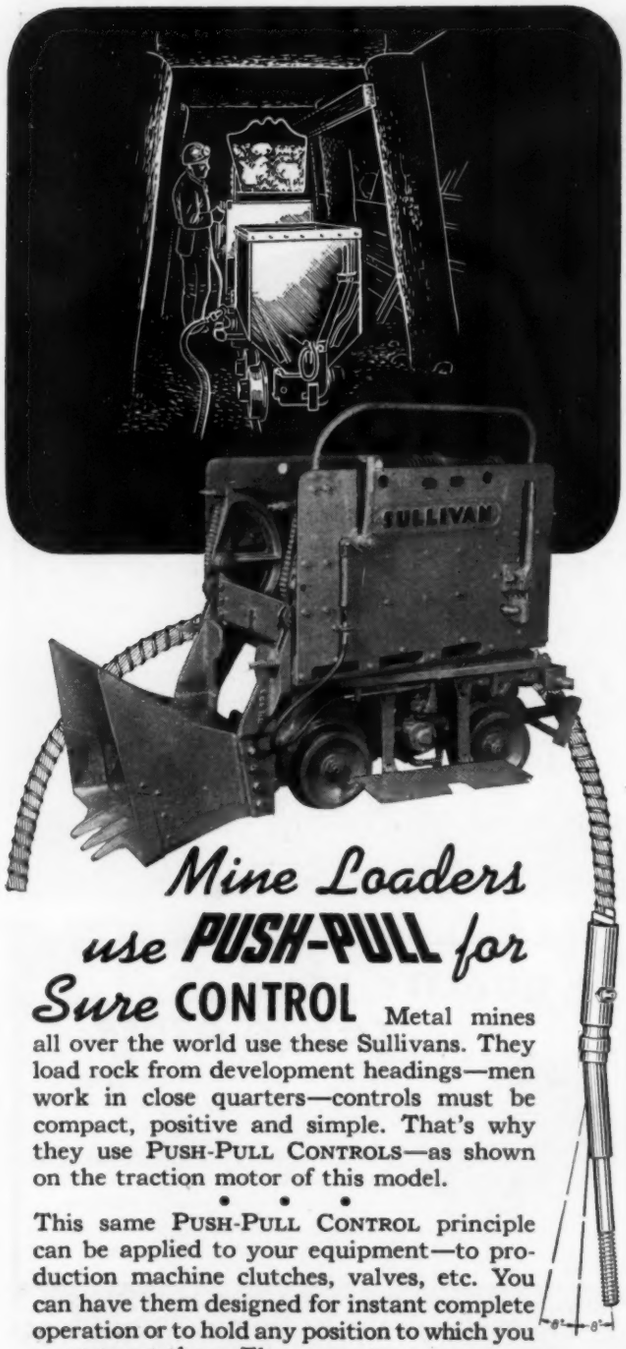

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Left — Single Clutch with pulley.

Below — Double Clutch exterior.

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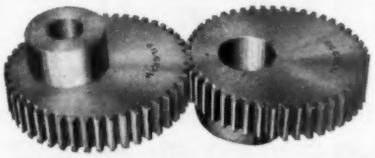

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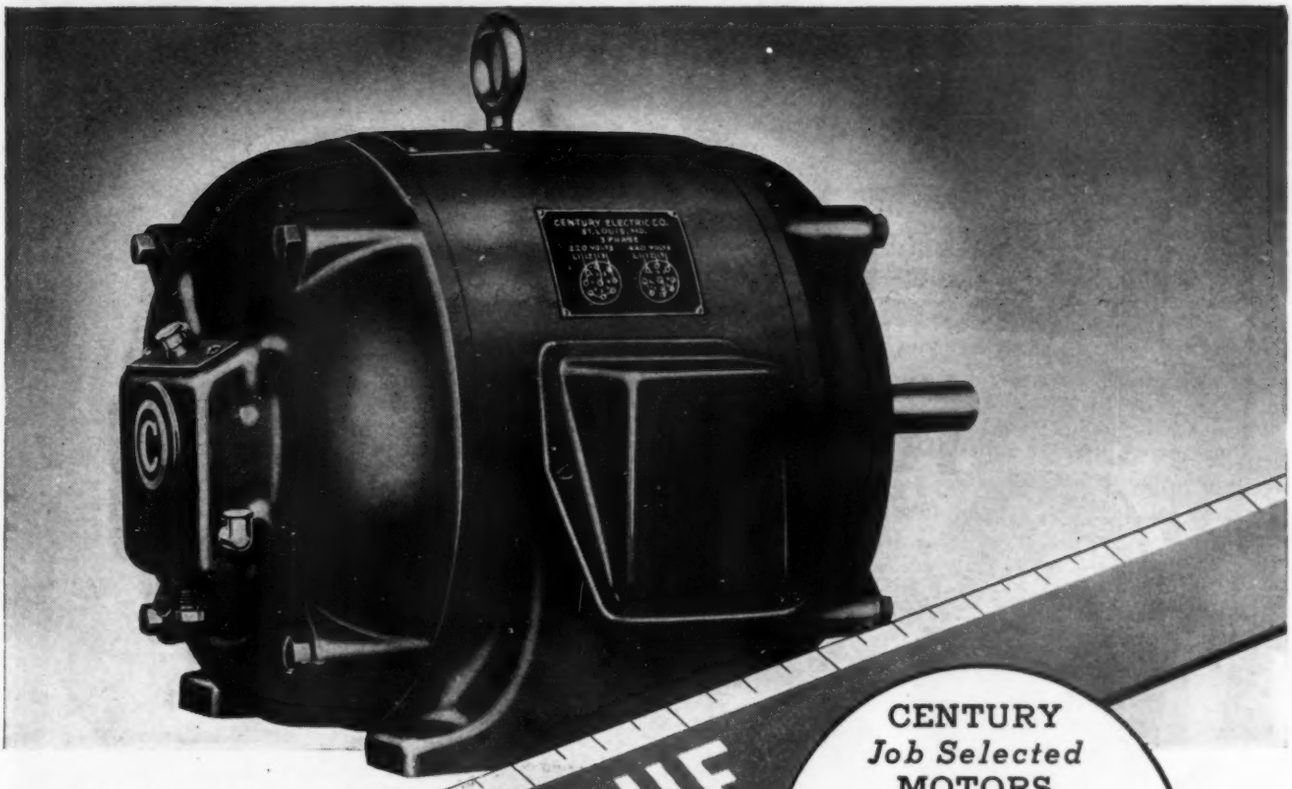
With our modern facilities we can produce all types of gears in any material, quantity or size—*promptly — economically.*

Take advantage of our experience of "OVER A QUARTER OF A CENTURY MAKING GEARS." Ask for a Braun estimate.

BRAUN GEAR CO.
1590-1608 ATLANTIC AVE., BROOKLYN, N.Y.

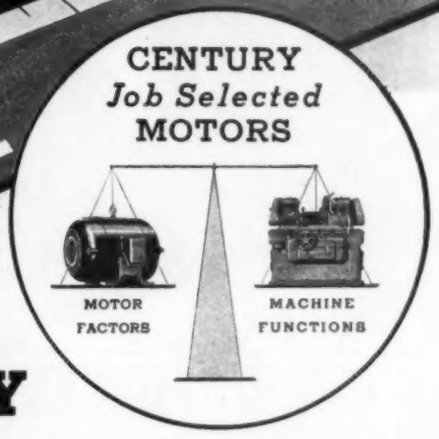


MEASURE THE

EXTRA VALUE

OF CENTURY

Job Selected MOTORS!



When you buy or specify Century Job Selected Motors you get more than the value inherent in Century's high quality of design and construction—more than the value of 38 years of experience in building electric motors for every application.

Century Job Selected Motors offer you the extra value of knowing that the motor fits the demands of its job and surrounding atmospheric and operating conditions. With Century Job Selected Motors you can prevent unnecessary operating and production costs; often increase production and better assure long periods of continuous, heavy duty service.

Whatever the requirements peculiar to your plant or your product, there is the Century Job Selected Motor specifically engineered to meet the demands of the load and, if necessary, protected against unusual surroundings. Century Motors are available in a wide variety of types and sizes from fractional to 600 horsepower.

Century Job Selected Motors may solve many a production problem for you, too. Get all the facts, get the complete story of Century's extra value. Let your nearest Century Motor Specialist help you with your motor problems —there are 31 Century branch offices to serve you, an important service today when quick action is so essential. 'Phone or write for Century engineering service.

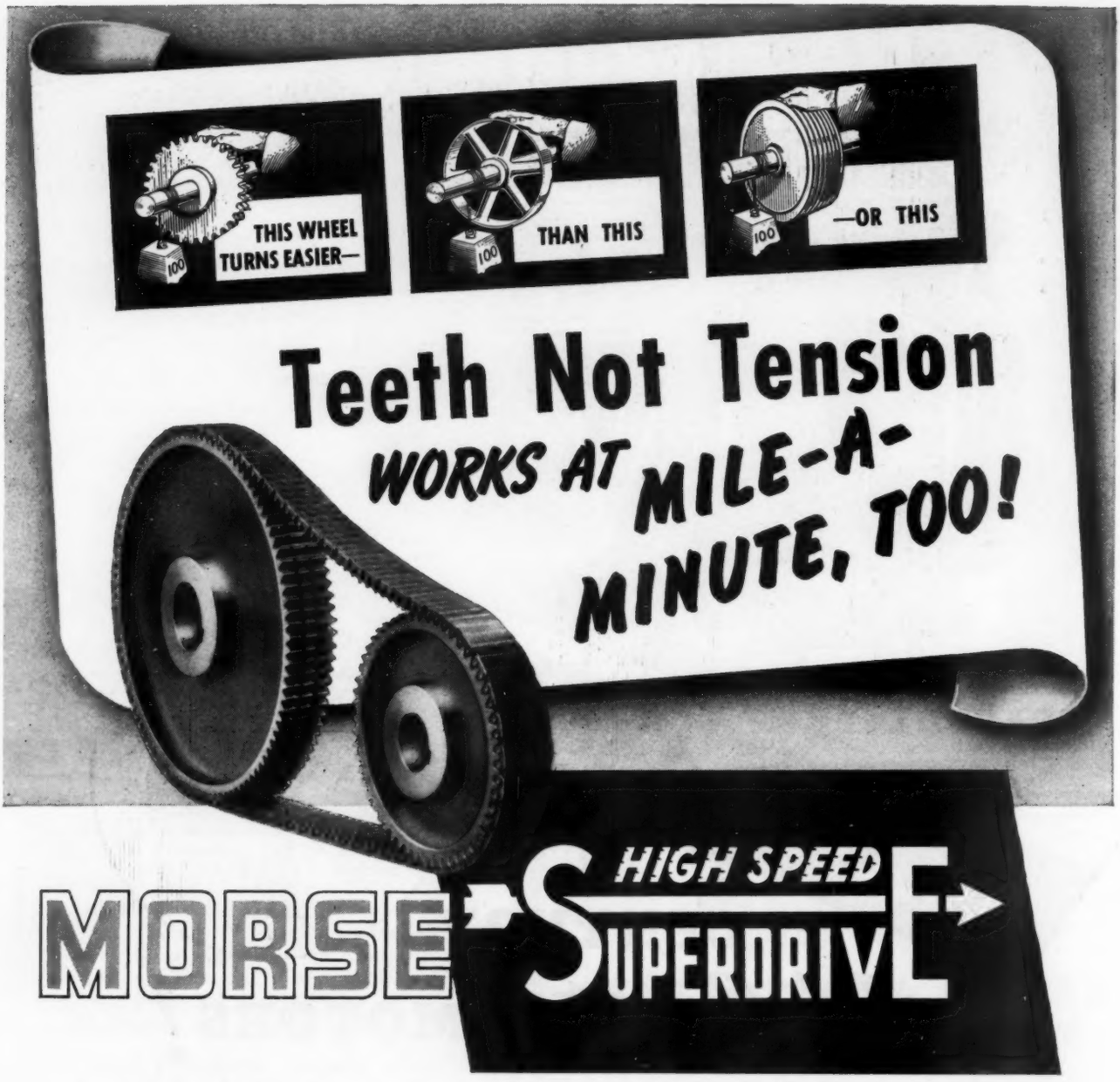
CENTURY ELECTRIC COMPANY

1806 Pine St., St. Louis, Missouri

Offices and Stock Points in Principal Cities

Century MOTORS

One of the Largest Exclusive Motor and Generator Manufacturers in the World



IN THE Morse High Speed Superdrive, you get all the advantages of silent chain drives—strength, flexibility, positive efficiency, low maintenance cost, adaptability—plus very important advantages which belong exclusively to the High Speed Superdrives.

Superdrives achieve chain speeds of a mile-a-minute and more with the same motor r.p.m.'s, through the use of larger sprockets with more teeth. The added speed of the chain accomplishes remarkable results. Power transmitting capacity of the drive rises rapidly—even faster than the speed of the chain increases. Centrifugal force goes to work *for* the drive, spreading stresses thin and evenly over the teeth of chain and sprocket, resulting in smooth, quiet operation in which wear is so small that it can scarcely be measured.

And because the capacity is increased so sharply, Morse High Speed Superdrives can be amazingly compact. On a recent drive, the Superdrive engineered design called for chain ⅓ the width which conventional low-speed drive design would have recommended!

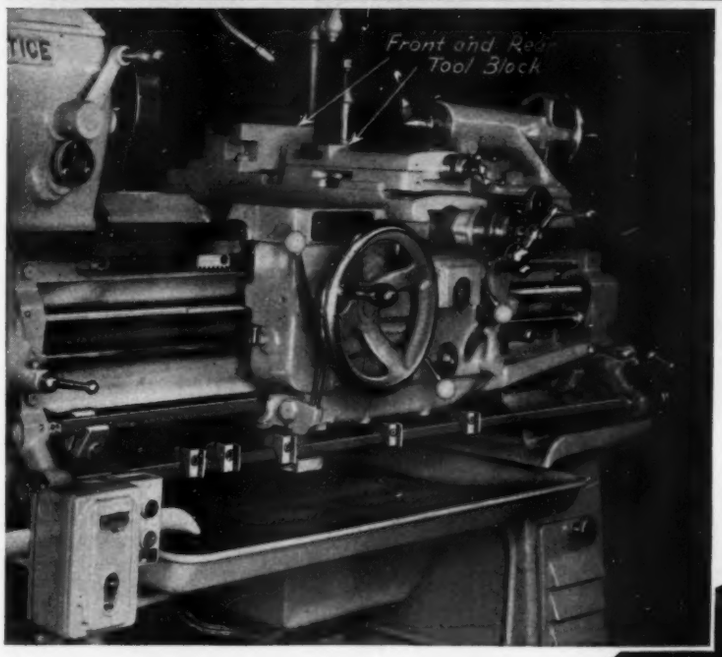
Here's a drive for high-speed operation which has plenty to offer. It's compact, efficient, long-lived, economical to operate, costs no more than other types of high-speed drives. Get complete information on Morse High Speed Superdrives from the Morse man near you, or write direct to Morse, Ithaca.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

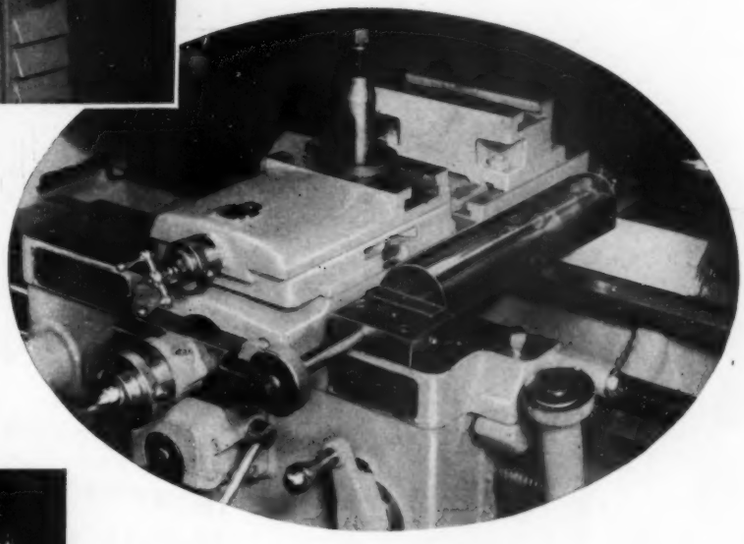
MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

NEW Production Features for REED-PRENTICE Lathes



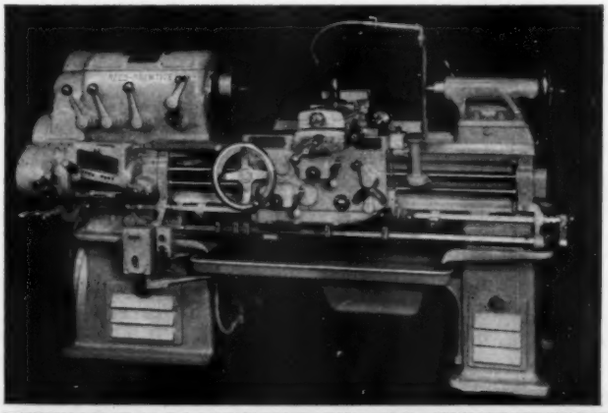
Reed-Prentice Engine Lathes, equipped with these new production features, are flexible, easy to operate, and will step-up output of lathe work whether in large or small lots.

Automatic Multiple Length Stops, shown at left are for accurately duplicating shoulder lengths on repetition work. After stop dogs are positioned on sliding bar at front of the lathe, the feed is automatically disengaged as stop handle comes in contact with dogs.



Adjustable Multiple Cross Stops, illustrated at right with chip guard in phantom, are for accurately duplicating diameters on repetition work. Stops are adjustable for series of diameters and are rotated into position by knurled knob at front for contacting hardened stop dog attached to compound rest cross slide.

Front and Rear Tool Blocks, also shown in these views, permit multiple tooling in varied combinations to suit requirements.

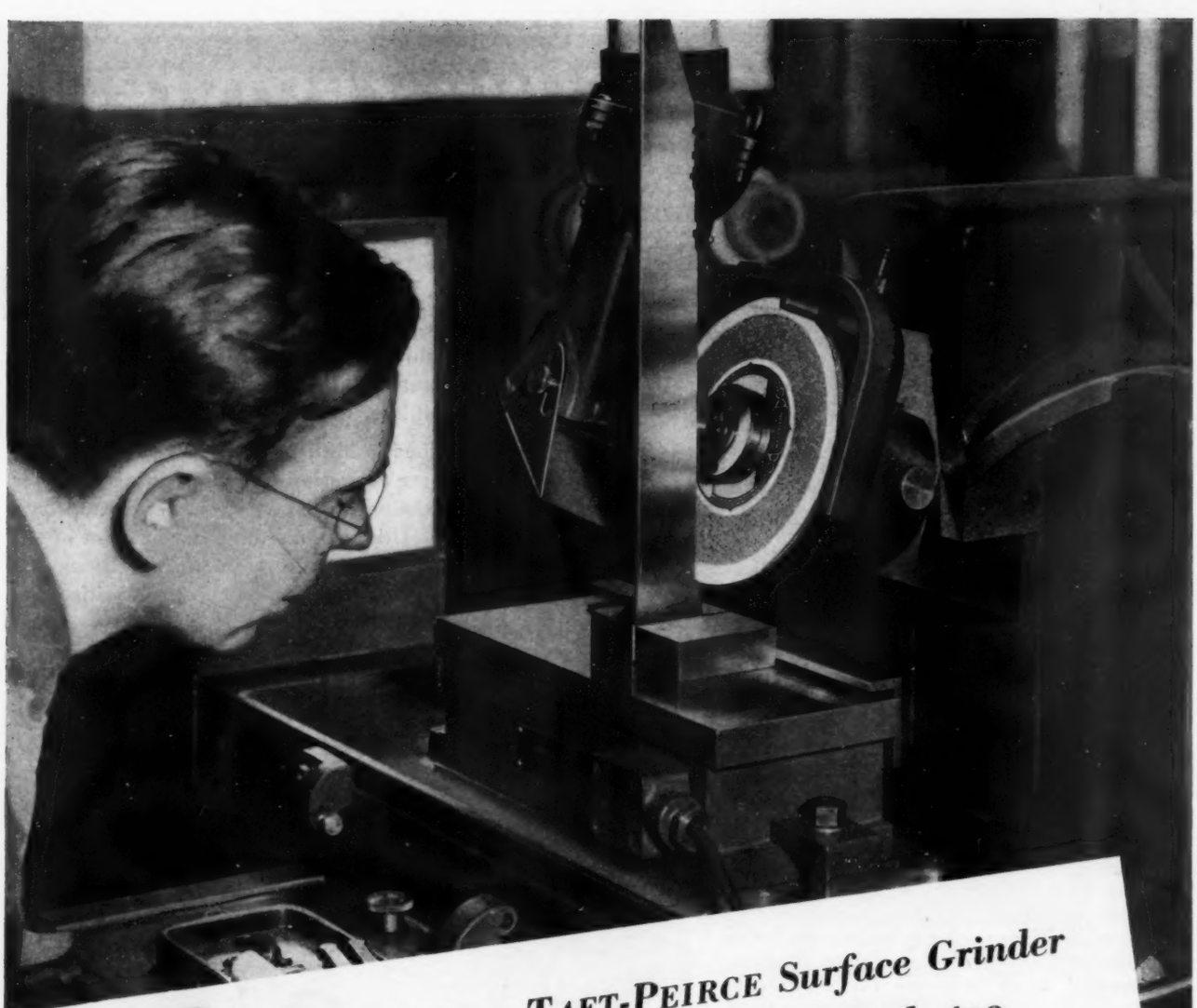


Reed-Prentice Engine Lathes, of standard construction and fitted with latest productive attachments, will often eliminate the necessity for costly special machinery with extended deliveries. **New increased plant capacity enables us to quote prompt deliveries on 14″–16″ or 20″ Engine Lathes and 14″ or 16″ Toolroom Lathes. We shall be pleased to submit detailed proposals promptly and without obligation.**

Main Office
677 Cambridge St.
Worcester, Mass.

REED-PRENTICE CORP.
MACHINE TOOLS

Branch Office
75 West St.
New York, N. Y.



This Unique TAFT-PEIRCE Surface Grinder does Angle and Shoulder Work, too

- ✓ MORE ACCURATELY
- ✓ IN SHORTER TIME
- ✓ ON ALL SMALL TOOLS AND PARTS

(Grinding step of shoulder on contour and length gage. *Guard is removed to show wheel.*)

The Wheel Spindle of the No. 1 Precision Surface Grinder swivels in a vertical plane about the wheel-center. So a simple spindle-adjustment permits grinding operations which formerly required difficult set-ups. Slots, dovetails, and undercuts can be finished with the angular face of the wheel *instead of the side,* saving time and wheel-wear and producing a far higher grade of finish with far less effort by the operator.

This grinder was built to produce the finest tool and gage work, up to 5″ x 12″ x 12″. Vertical, longitudinal, and transverse travel are on hardened and ground ball-bearing guides, to assure friction-freedom, long life, and maintenance of precision. Write for descriptive bulletin on the No. 1 Precision Surface Grinder

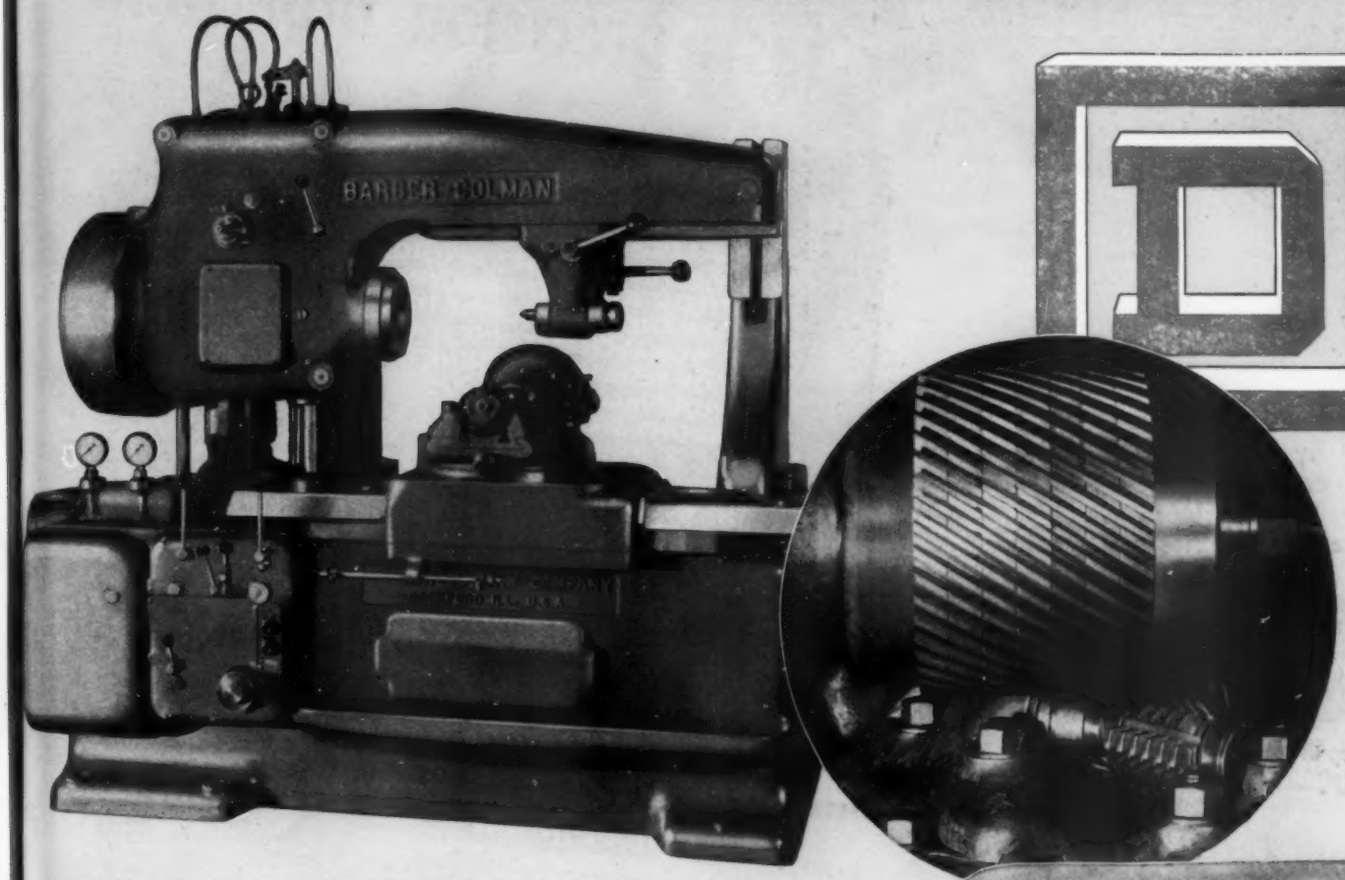
THE TAFT-PEIRCE MANUFACTURING CO.

WOONSOCKET, RHODE ISLAND

9763

More Machine Tools

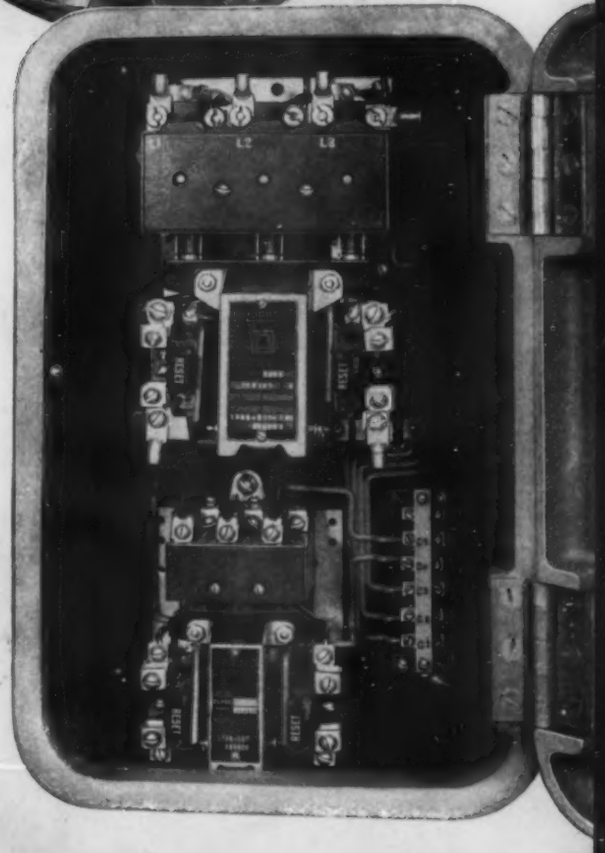
with SQUARE D CONTROL



ABOVE • This Barber-Colman Type D hydraulic hobbing machine cuts gears in one operation; eliminates any succeeding operations formerly required.

RIGHT, ABOVE • Hobbing tractor cam shaft gears—seven per load, at rate of approximately 40 minutes per loading. Fine finish and great accuracy are required.

RIGHT, BELOW • Square D motor control—on the job where consistent performance is an essential.



With a new and much larger factory in smooth operation, the Industrial Controller Division of the Square D Company is increasing production as fast as new equipment and materials can be obtained. A major part of its output is going toward national defense—through the machine tool industry and industrial plants.

The Square D line of electrical equipment is complete for all industrial requirements. There are Square D district offices with engineering service in all industrial centers. Competent counsel is available to any design engineer or factory executive faced with problems of motor control or plant equipment. Consult your telephone book and—

CALL IN A SQUARE D MAN

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

IN CANADA: SQUARE D COMPANY CANADA LIMITED, TORONTO, ONTARIO

MACHINE TOOL BUILDERS take advantage of LAPOINTE EQUIPMENT for fast, precision broaching

Note the names of the builders—each one qualified by individual specialized experienced to analyze production problems and look for the solution. These nationally recognized manufacturers have taken advantage of Lapointe's pioneering experience in the art of broaching to help them meet their urgent needs.

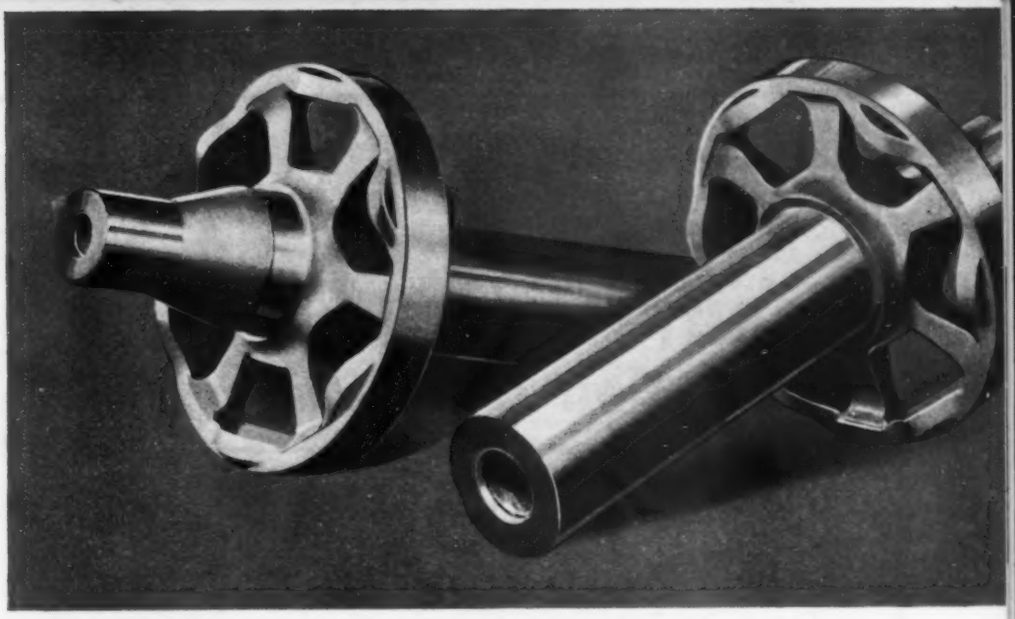
The Leland Gifford Company is one of the many machine tool builders to apply Lapointe speed and accuracy in the production emergency imposed by the National Defense Program.

"When you think of Broaching, think of LaPointe"—just as many other manufacturers have done. Ask Lapointe to show you how you can step up the production of flat, curved or irregular surfaces as well as all types of cylindrical work. Lapointe Broaching Machines and Broaches invariably insure high precision and high production when they are fitted to the job by Lapointe.

THE INGERSOLL MILLING MACHINE CO.
CLEVELAND AUTOMATIC MACHINE CO.
GIDDINGS & LEWIS MACHINE TOOL CO.
THE NATIONAL AUTOMATIC TOOL CO.
NEW BRITAIN-GRIDLEY DIVISION
POTTER & JOHNSTON MACHINE CO.
INTERNATIONAL MACHINE TOOL CO.
THE MONARCH MACHINE TOOL CO.
LODGE & SHIPLEY MACHINE TOOL CO.
GISHOLT MACHINE CO.
BARDONS & OLIVER, INC.
W. F. & JOHN BARNES CO.
BARNES DRILL CO.
THE BULLARD CO.
GEOMETRIC TOOL CO.
LELAND GIFFORD CO.
GLEASON WORKS
THE G. A. GRAY CO.
HANSON-WHITNEY MACHINE CO.
THE HEALD MACHINE CO.
THE HENDEY MACHINE CO.
ILLINOIS TOOL WORKS
JONES & LAMSON MACHINE CO.
KENT-OWENS MACHINE CO.
LANDIS TOOL CO.
THE NATIONAL ACME CO.
NORTON COMPANY
RACINE TOOL & MACHINE CO.
REED-PRENTICE CORP.
RIVETT LATHE & GRINDER, INC.
ROCKFORD MACHINE TOOL CO.
SOUTH BEND LATHE WORKS
UNIVERSAL BORING MACHINE CO.
AMERICAN TOOL WORKS
CONE AUTOMATIC MACHINE CO.
PRATT & WHITNEY DIVISION
TAFT-PEIRCE MFG. CO.
FELLOWS GEAR SHAPER CO.
WARNER & SWASEY CO.
SIDNEY MACHINE TOOL CO.
LUCAS MACHINE TOOL CO.
BROWN & SHARPE MFG. CO.
FOSTER MACHINE CO.
KING MACHINE TOOL CO.
CARLTON MACHINE TOOL CO.
SENECA FALLS MACHINE CO.

HUDSON LAPOINTE MASS.

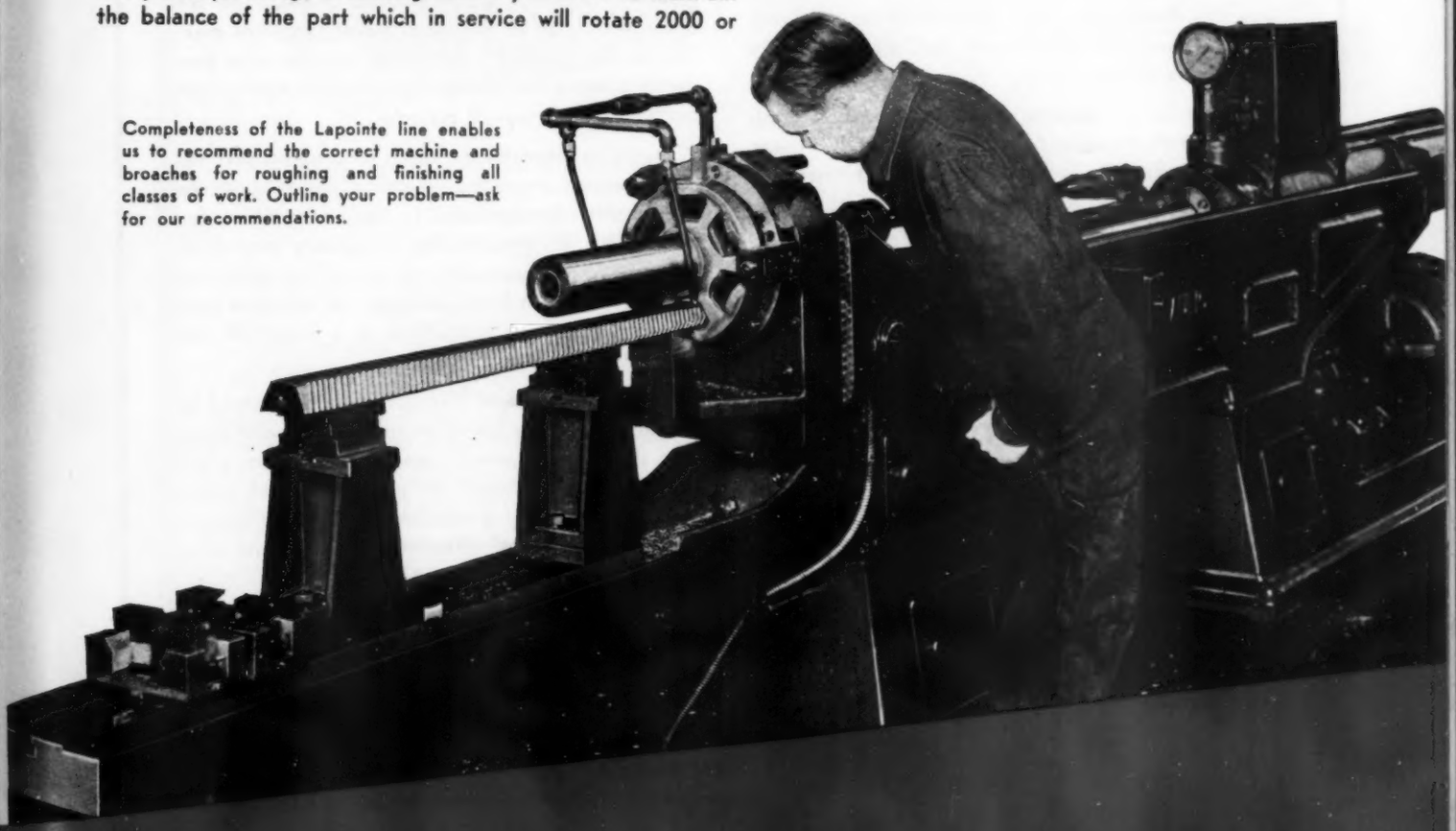
LAPOINTE



The spokes of these aircraft propeller shafts are produced by seven identical broaching operations on the Lapointe 3L Broaching Machine shown below at the plant of Leland Gifford Co., Worcester, Mass.

This job requires high broaching accuracy in order to maintain the balance of the part which in service will rotate 2000 or more revolutions per minute. These and other parts of equally high precision are produced on this Lapointe machine—outstanding proof of the ability of Lapointe equipment to produce clean, accurate, finished parts in one quick, efficient operation.

Completeness of the Lapointe line enables us to recommend the correct machine and broaches for roughing and finishing all classes of work. Outline your problem—ask for our recommendations.



HUDSON, MASSACHUSETTS, U. S. A.

MACHINE TOOL COMPANY

COSTS . . .

PROMPTLY AVAILABLE ! *when You Need Them !*

Costs must be available promptly today or they have little value. . . . . .

The pace is too swift for reliance on records that are past history when they reach you.

THE St. Charles Manufacturing Company, St. Charles, Illinois, manufacturer of modern steel cabinets, steel kitchens, and sheet metal products for the Army and Navy, for institutions and residences, have cut corners with McCaskey to secure their data without delay:

"Our plant is operated on a standard cost basis and prompt, accurate records are required to measure the efficiency of the various departments in comparison with existing standards. McCaskey Controls give us this information with a minimum of clerical expense.

"A three copy labor ticket provides data for distributing both productive and non-productive labor departmentally and for accumulating a record of the labor expended on individual manufacturing orders. Variances from standards thus are promptly revealed, localized to the point of origin. The use of another copy of the labor ticket simplifies making-up the pay-roll. All three records are prepared without the multiple postings necessary with most cost and pay-roll systems.

"Operating department heads and supervisors receive reports promptly, enabling them to locate and rectify discrepancies in their respective departments. Information for budgetary control of expenses also is promptly available at no additional expense. Many of the problems of effective cost control have been simplified as a result of the flexibility of McCaskey methods.

"McCaskey Perpetual Inventory also has served us well in keeping our stores inventory of several thousand items under proper control. McCaskey planning boards are used for job assignment. We consider McCaskey a valuable aid in many ways—a modern tool, most effective in the conduct of a modern manufacturing plant."

Write for

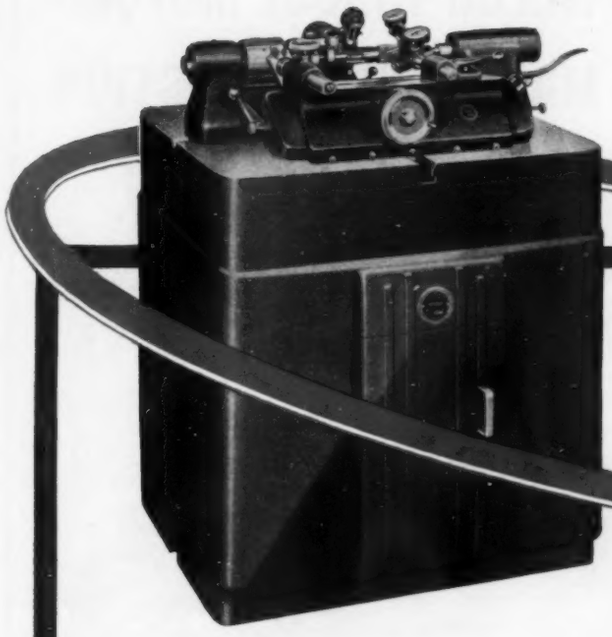
"Cost and Payroll Distributions without Posting,"
or pamphlets descriptive of other McCaskey Controls.

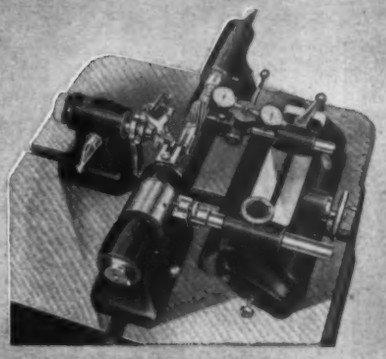
●

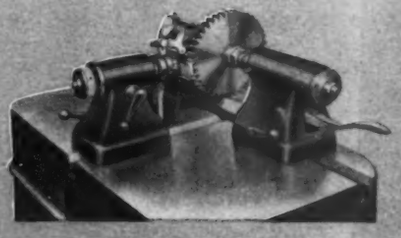
THE McCASKEY REGISTER COMPANY, ALLIANCE, OHIO

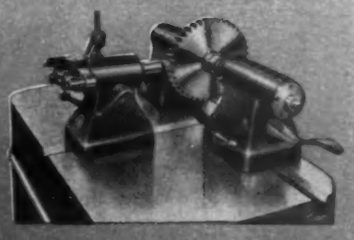
McCASKEY INDUSTRIAL CONTROLS
PRODUCTION • INVENTORY • MAINTENANCE • TOOLS • COSTS • PAYROLL

Speed Up GEAR CHECKING WITH RED RING UNIVERSAL GEAR TESTER AND RED RING HELICAL GEAR LEAD COMPARATOR









Red Ring Universal Gear Testers will check index, interference, helix angle, wobble, eccentricity and tooth size of the ordinary small gear in less than a minute, making it useful for production inspection.

Operation is simple, easy—requires no extraordinary skill. Readings are to .0001".

The Red Ring Helical Gear Lead Comparator compares the lead of each tooth to that of a precision master gear, or to a master disc. Set up is simple and easy, and once the job is set up almost any workman of average skill can make the inspections.

Gears integral with the shaft—arbor mounted gears—or internal gears may be checked.

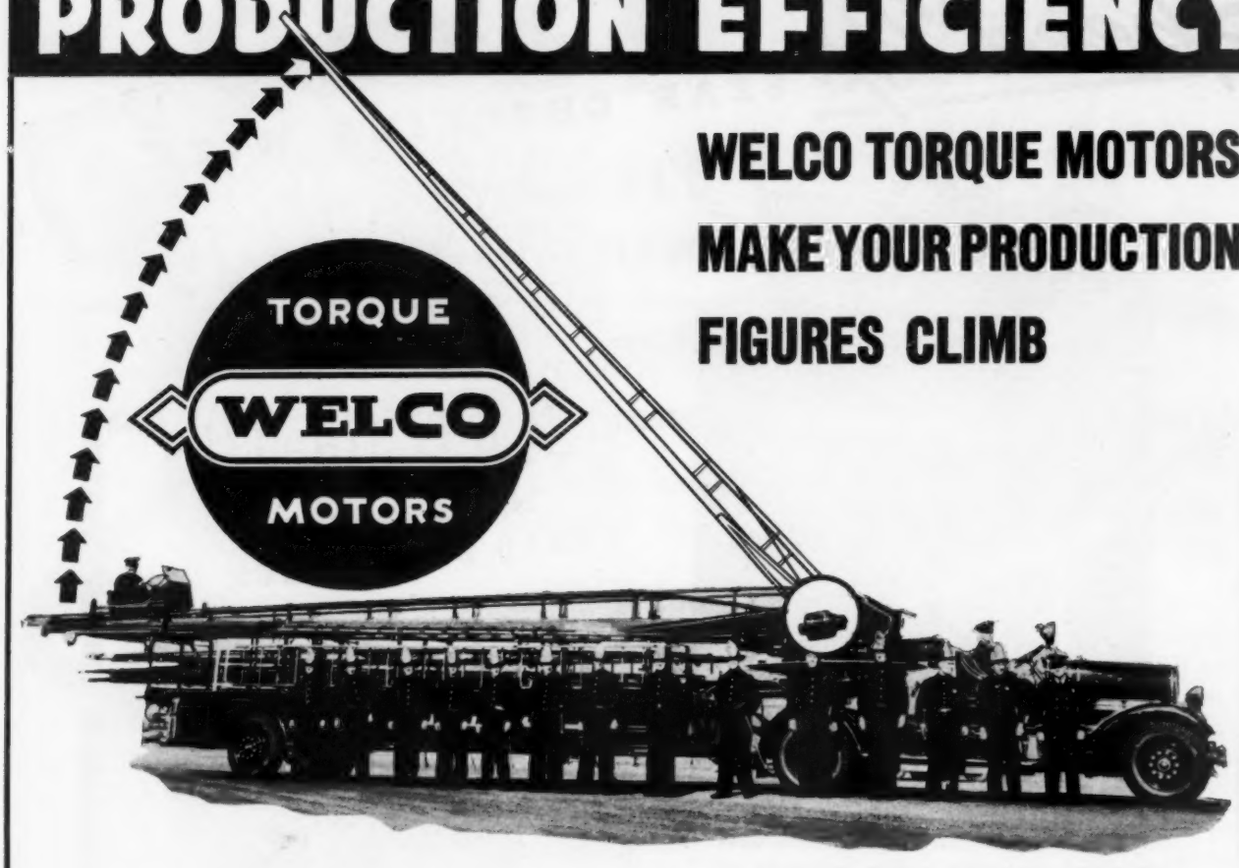
Both gear testing machines are extremely sturdy, high precision instruments. They will make a large reduction in gear inspection time and cost.

Write for data on these and other Red Ring Machines.

NATIONAL BROACH AND MACHINE CO.

5600 ST JEAN • DETROIT, MICHIGAN

PRODUCTION EFFICIENCY



WELCO TORQUE MOTORS MAKE YOUR PRODUCTION FIGURES CLIMB

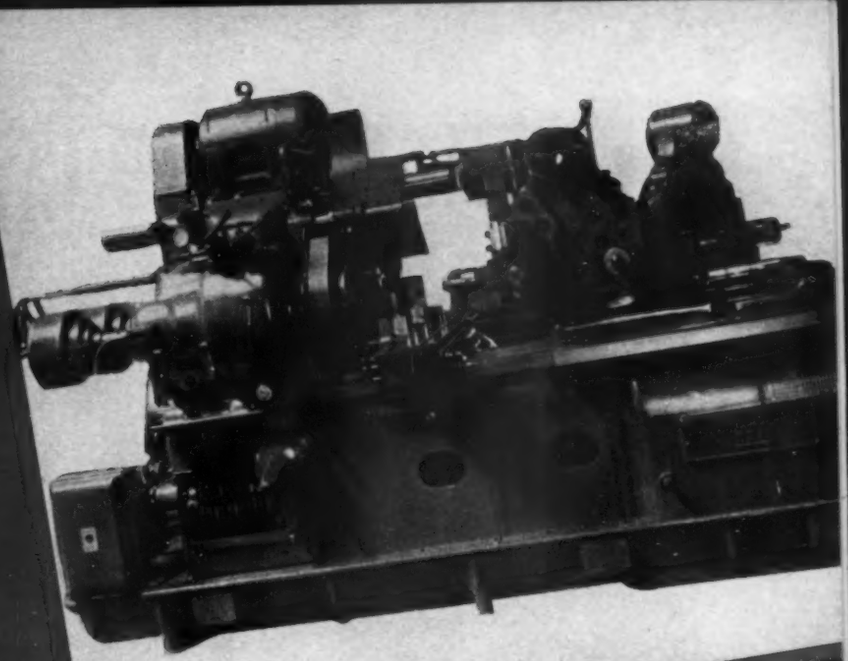
A Welco Torque Motor raises and lowers the 65 ft. ladder of this fire truck in 7 seconds—and wherever there is need of unfailing power in emergency, whether fire or the more serious emergency facing today's production schedules, there you will find Welco Torque Motors.

Raising, lowering, clamping, indexing, performing a hundred and one time saving motions on machine tools and other production machinery, simple, direct Welco Torque Motors bring power *where the power is needed.* Maximum power at the start—speed control all the way to a complete stall—rapid reverse.

Our engineers are ready to tackle the job of building *the* motor for your power needs. Write today for detailed information. Address Dept. 103.

The B. A. WESCHE ELECTRIC CO., 1626 Vine St., Cincinnati, Ohio

Operating gears for Curtiss-Wright Variable Pitch Aircraft Propellers COMPLETELY FINISHED on P&J 5-D TWO SPINDLE AUTOMATIC CHUCKING and TURNING MACHINES



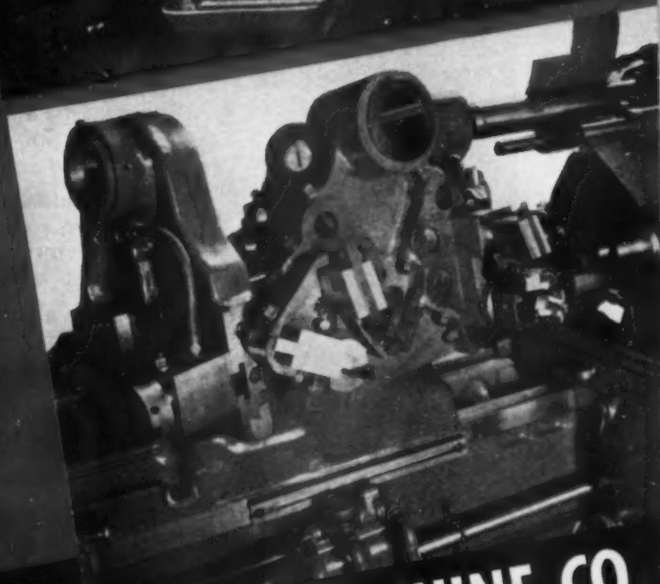
FLOOR to FLOOR TIME... approximately 16 MINUTES

For work within its range, this P&J machine offers an output from two spindles in a floor space equivalent to that required by a single spindle unit. Then, too, savings in power and initial investment are realized as compared with two single spindle machines.

The gear—a steel drop forging—is machined in four holdings with two opposite-face roughing operations being performed simultaneously. It is then heat treated and the second two finishing operations are handled during the same cycle.

A cross slide unit operates in conjunction with the turret slide, providing for rough and finish facing cuts and operation of slide tools mounted on turret. Design of overhead pilot, standard on this machine, assures an effective tie between headstock and turret slide. The illustrations show clearly the rigidity and simplicity of the tooling.

The gear blank being machined—an aircraft part—requires a high degree of both accuracy and finish. Yet one operator can handle three P&J Two Spindle machines and easily turn out work to exact specifications — at the rate of 3 rough and finished blanks per 51-minute hour.



DETAILS OF OPERATIONS

The first and second roughing operations are performed simultaneously on rear and front spindles. Large open end of blank is presented to rear spindle with grip on O.D. Small end of blank is presented to front spindle and gripped on portion of O.D. machined on rear spindle. Operations on the two spindles include spot drilling hole, drilling hole, rough turning O.D., rough facing, semi-finishing and finishing small gear diameter and bore of large gear diameter.

Floor to floor time for roughing operations—15.55 minutes.

After machining all over as above, the parts are heat treated to 310 Brinell before simultaneously finishing on rear and front spindles with large and small ends presented to spindles as in the rough operations.

Floor to floor time for finishing—32 minutes.

Complete information as to details of operations, speeds and feeds is available on request.

POTTER & JOHNSTON MACHINE CO.

Pawtucket, Rhode Island

H&G DIE HEADS
Keep Production Rolling

"An extra hour every day"

IT'S a TWO minute job to change H & G Insert Chasers. A NEW set is installed in the carriers with no more bother than putting a new blade in a safety razor. This feature makes for uninterrupted production — vitally important when threading the tough alloys now so largely specified on all defense equipment.

When chasers get dull a new set is immediately substituted and production continues. Non-productive time for both operator and machine is practically eliminated—decreasing costs and increasing earning power. Like gaining an extra hour every day.

The threads cut establish new standards for quality and accuracy. The low chaser cost and superior wearing qualities provide a lower tool cost per thousand pieces.

H & G Insert Chaser Die Heads are available in a wide range of styles and sizes for every machine on which threads are cut.

Write for New Bulletin

"DEFENSE EMERGENCY SCREW THREAD DATA BOOK"

Including Foreign Thread Systems.
Available to factory executives upon request on business letterhead; others, 15c.

THE EASTERN MACHINE SCREW CORP.
20-40 Barclay St., NEW HAVEN, CONN.

A dribble or a Deluge

RUTHMAN
GUSHER
COOLANT PUMPS

Adaptable to virtually any machine tool made . . . for jobs requiring small quantity of coolant. Gusher model P-3 saves power consumption and speeds work. Has built-in motor, sturdy vertical shaft on ball bearings, double suction intake, giving balanced impeller. Gusher models are available in 1/30 to 2 H.P. and have capacities from a dribble up to 200 g.p.m. Write for data and specifications.

P-3 is available in external right or left discharge models, flange-mounted and immersed models.

THE RUTHMAN MACHINERY CO.
1809 READING ROAD, CINCINNATI, OHIO
LARGEST EXCLUSIVE BUILDERS OF COOLANT PUMPS

SMACK IT WITH A SLEDGE!

SOAK IT IN OIL!

BUILD A BONFIRE ON IT!

Pat'd. and Pat's. Pending
Fig. 732 Drawer is extra

THESE
HALLOWELL
STEEL BENCHES

can never splinter or split, lose their rigidity, or become oil soaked fire hazards as do ordinary wooden benches.

"Hallowell" Steel Benches defy time and abuse—shrug off treatment that reduces your wooden bench to a pile of kindling.

That's because they have heavy gauge steel tops and heavy, flanged steel leg construction (pyramid type so it is unnecessary to fasten them to the floor). They're impervious to oil, and to fire, and they keep their smooth working surface.

Further, you can move them wherever, whenever you wish without impairing their rigidity in the slightest; use them separately; put them end to end to form a smooth, continuous working surface.

Prices?—no more than the cost of building a home-made bench yourself! And there are more than 1,300 STOCK STYLES from which to choose. Catalog describes them; write for it.

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. Box 4
— BRANCHES —
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

THEY GET INTO CLOSE-QUARTERS

When the job demands "wrench power" in the lightest, trimmest form possible . . . these extra-strong, chrome-molybdenum "Superrenches" are the answer. For close-quarter work in hard-to-reach places they have no equal. They are made in all popular Open-end patterns; in the thin-walled 12-point Box patterns which will completely rotate a nut when handle swing is limited to only 30°, and in various special types designed for specific service. They are fine, well-balanced tools —all durably finished in chrome plate.

"Superrenches" are part of the complete Williams line which includes both Carbon and Alloy steel types for practically every industrial need. Williams' "Superior" Wrenches are drop-forged from specially-processed carbon steel and, although less costly, are practically as strong as corresponding alloy steel types. They are made in more than 50 popular patterns—over 1,000 standard sizes.

Williams' Wrenches are sold by industrial distributors everywhere. Industrial wrench users are invited to write for a free copy of "How to Select and Use Wrenches." I-671

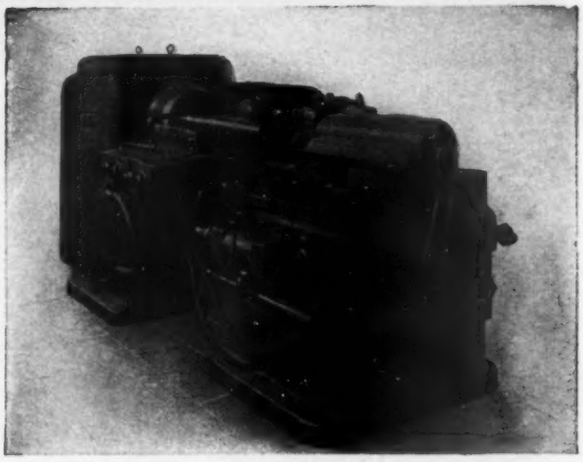
J. H. WILLIAMS & CO. HEADQUARTERS FOR **225 LAFAYETTE ST., NEW YORK**

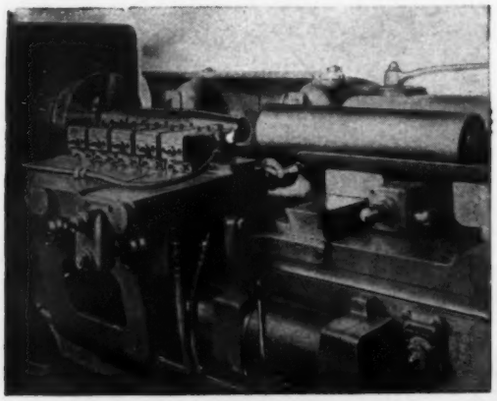
MOREY "27" Semi-automatic Lathe

. . . for many shell operations

"Designed to operate at the maximum feed and speed that the work and tools will permit." Thus cutting time is kept to a minimum. Loading from conveyor belt takes only five seconds.

Write, phone, or wire for complete details.





CLOSE-UP shows the "27" Semi-automatic Lathe tooled for rough turning, cutting-off, and facing Shell. Machine shown with rough forging, ready to slide on the arbor.

MOREY "27" Semi-automatic Lathe tooled for rough turning, cutting-off, and facing 155 MM Shell. Machine shown with Logan hydraulic arbor and tailstock in loading position.

MOREY MACHINERY CO., INC.

410 Broome St. New York, N. Y.

MORE PRECISION WORK
RIVETT
Spring Tempered
COLLETS
THE VISE TEST – to demonstrate true spring temper any Rivett collet can be clamped in vise, each jaw distorted by pressure or leverage and when mounted in spindle the hole will run perfectly true
ORDER FROM STOCK – collets and draw-in attachments for all standard lathes, millers and grinders can be furnished from stock
Write for Bulletin 100B
RIVETT LATHE & GRINDER INC.
BRIGHTON BOSTON MASS.
PIONEERS IN BENCH LATHE DEVELOPMENT

SHELDON Back Geared Screw Cutting PRECISION LATHES

For production:

Lever Operated Double Tool Posts

Lever Operated Collet Attachment

Lever Operated Tailstock

For any production jobs (often on second operation work) these moderate priced lathes will surpass in output much more expensive machine tools. Costing less than $750. (with motor included) the 10" Sheldon Manufacturing Lathe (illustrated) comes with Hand Lever Collet attachment (Collet capacity ¾"), Lever operated Double Tool Slide, Hand Lever Tailstock, Full-Quick Change Gear Box. With 4-speed underneath motor drive enclosed in pedestal leg. It's a complete operating unit that can be set up anywhere.

Write for Catalog of 10", 11" and 12" Sheldon Precision Lathes.

SHELDON MACHINE CO., INC.

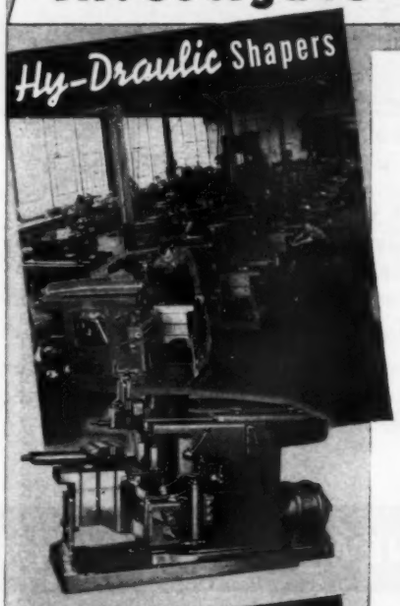
1635 No. Kilbourn Ave., Chicago, Illinois, U. S. A.

RECIPROCATING

Hy-Draulic

MACHINE TOOLS

Investigate Their Exclusive Advantages



THE hydraulic drives and feeds of Reciprocating Hy-Draulic Machine Tools are pioneer developments which provide numerous exclusive advantages. These include uniform speed and pressure throughout the cutting stroke; infinite adjustment of feeds and speeds within wide range; instant shockless reversals; finer finish on work; unusual productive capacity and operating convenience.

Shapers—12" High Speed Shaper, fastest built, is described in Bulletin HS-8 . . . Standard Shapers, 16", 20", 24" and 28", give peak output and accuracy for indicated range; see Bulletin 401.

36" Openside Shaper is best for long, heavy shaping; has shaper speed, planer accuracy. Full details in Bulletin 382.

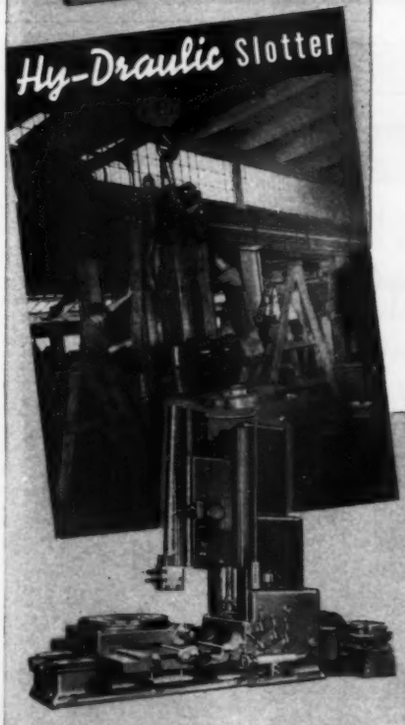
Slotter has 20" rating, 36" stroke, 41½" effective radius. Latest and most advanced tool of this type. Refer to Bulletin 404.

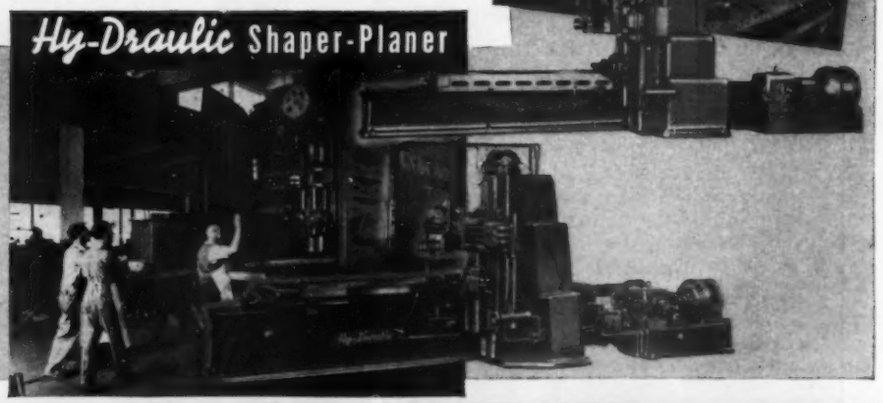
Shaper-Planers. For many jobs too big for shapers, too small for planers. Made in ratings from 66" to 144" stroke. Ask for Bulletin 3912.

Planers. Tremendously powerful, fast, accurate, smooth running. Openside Type shown at right, below; and in Bulletin 4011 . . . Double-Housing is described in Bulletin 395. Both types available in different sizes and lengths.

Investigate

Look into the advantages of Hy-Draulic Machine Tools, and anticipate your needs now to get suitable delivery. Bulletins listed above will be sent promptly upon request; and our engineers will gladly advise concerning specific applications. Write today.





Hy-Draulic
Reg. U. S. Pat. Off.

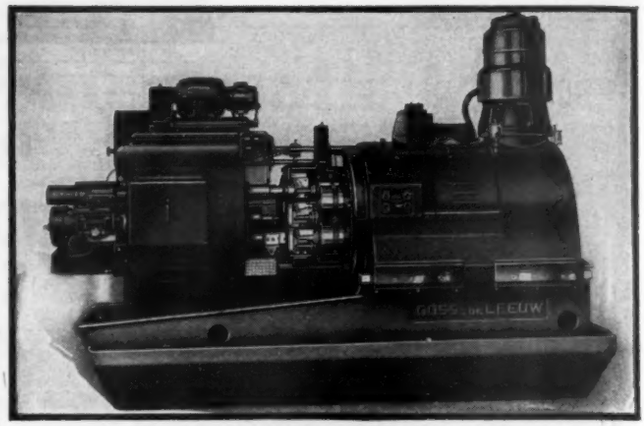
Shapers . . Planers . . Slotters . . Shaper-Planers

ROCKFORD MACHINE TOOL CO.

ROCKFORD, ILLINOIS, U.S.A.

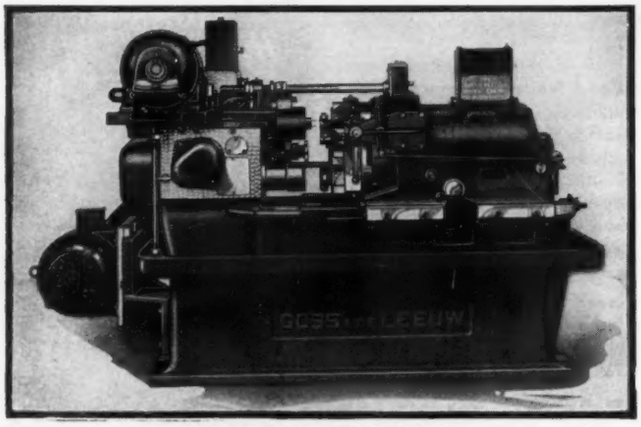
MADE IN ROCKFORD, ILLINOIS, U. S. A.

GOSS & DE LEEUW *Multiple Spindle* CHUCKING MACHINES



WORK ROTATING TYPE

5 Spindles • 6 Spindles • 8 Spindles



TOOL ROTATING TYPE

4 Spindles • 5 Chucking Positions

Both types of machines provide lead screw threading. Oversize spindles on these machines are mounted on pre-loaded anti-friction bearings. Ways are hardened; gears are of chrome-nickel steel, carefully heat-treated.

The many modern features offered in these machines are fully described in catalog available on request.

GOSS & DE LEEUW MACHINE CO., NEW BRITAIN, CONN.

How the leading Name IN HOLLOW SCREWS took the lead in 1910

By invention of the *COLD-DRAWING* process, Allen took the first advanced step in hollow screw manufacture. This process patented in 1910 added 30% to hollow screw STRENGTH.

Each succeeding advance in hollow screws has been made through *special-process* developments originating with ALLEN or encompassed by the original ALLEN Patent.

That's why the name has been broadly applied to ALL hollow screws that are sold. And by the majority of buyers, *specifically* applied to ALL HOLLOW SCREWS *THEY HAVE ORDERED!*

"SOMETHING NEW UNDER THE SUN"
Allen Patent Safety Set Screws
Made from high-test steel bars, and
Warranted to stand up to strenuous work.
Note thickness of metal at the point.
U. S. Patent June 7, 1910.
SCREWS NOW READY FOR DELIVERY.
Catalog and Testimonials Mailed Free.
The Allen Manufacturing Co., Inc.
135 Sheldon St., HARTFORD, CONN., U. S. A.

Above: The first advertisement of Allen Hollow Screws, which were truly "something new" *as advertised* in November 1910. They have been truly *as advertised* ever since . . .

HEX SOCKETED SCREWS — DIEMAKERS' ACCESSORIES

THE ALLEN MANUFACTURING COMPANY

HARTFORD • CONNECTICUT • U. S. A.

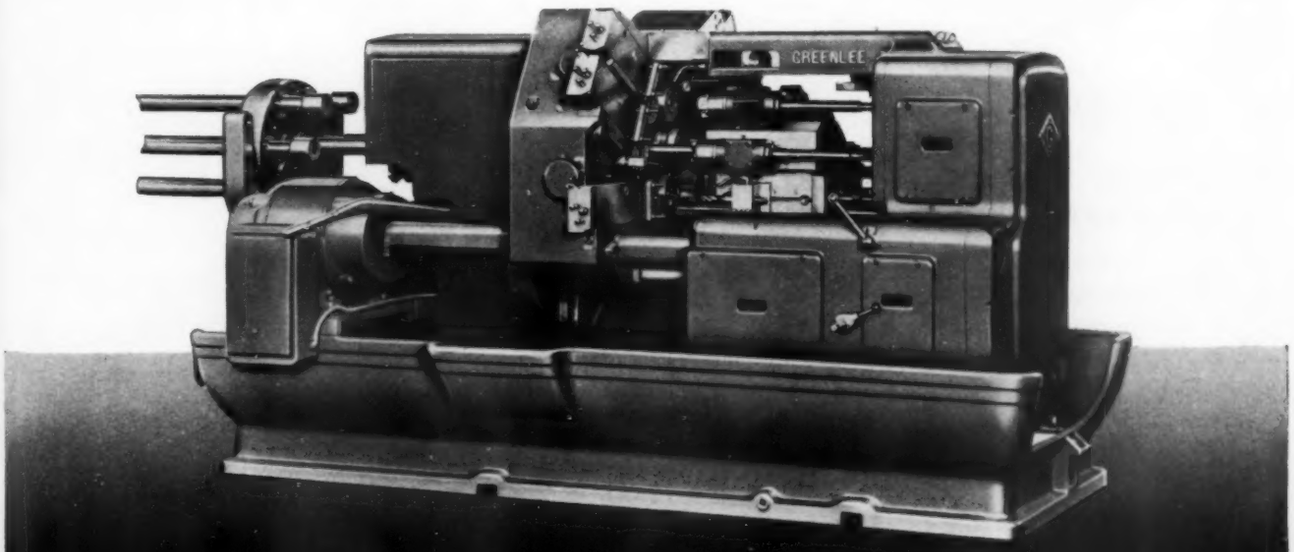
"AND THIS, TOO, SHALL PASS AWAY"

Eighty years ago Abraham Lincoln used this comforting statement during the crucial Civil War Period . . . it was repeated during World War I . . . and today again America is saying, "And this too, shall pass away."

To help this emergency pass away as fast as possible, America is hard at work. And here at Greenlee Bros. & Co. we're at work turning out Greenlee Automatic Screw Machines just as fast as we can build modern, accurate machines and do it right . . . machines that are doing an effective job today with defense work and will also give profitable production when we're back to normal peace-time operation. Today plants throughout Canada, England, and the United States are using the Greenlee speed and ease of operation and the Greenlee speed of setting-up and changing-over in producing vital defense parts . . . but this speed is only part of the story.

Greenlee Automatics are designed and built not only for today's needs, but also to meet tomorrow's tough competition. These Greenlee machines . . . built with a dependable continuous accuracy . . . designed and built to stand up under the hard and fast use of defense production . . . and with the flexibility to handle a wide range of work on both long and short runs . . . will be turning out ordinary peace-time parts at the lowest possible cost when this, too, has passed away.

GREENLEE BROS. & CO. ROCKFORD, ILLINOIS

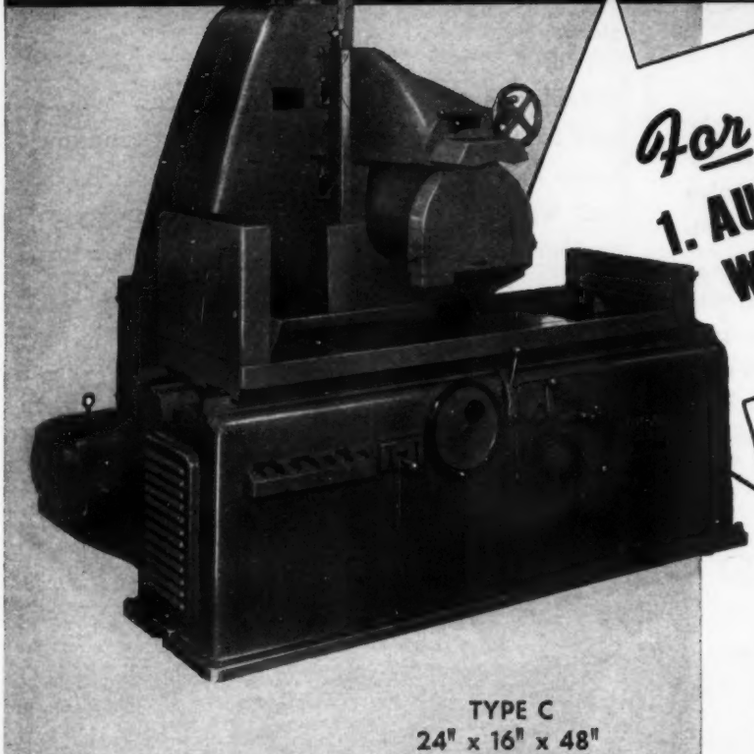


GREENLEE

Automatic Screw Machines

THOMPSON FEATURES

POINT THE WAY TO MODERN, LOW-COST PRECISION GRINDING



TYPE C
24" x 16" x 48"

For Instance—

1. AUTOMATIC HYDRAULIC WHEEL HEAD FEED

. . . PROVIDES EASY ADJUSTMENT BETWEEN 1/32 INCH AND HALF THE WHEEL FACE

All features of the Thompson line of Hydraulic Surface Grinders combine to give you greater accuracy for improved production and more economical operation for increased profit. Here, for instance, is provision for simple, convenient adjustment that speeds the work and contributes to the greater precision characteristic of Thompson performance. Full details included in our latest bulletin. Write today for your free copy.

CHECK THIS LIST OF FEATURES AGAINST ANY OTHER GRINDER!

- Automatic Down Feed
- Hydraulic Rapid Traverse (Pat'd.)
- Automatic Wheel Truing
- Power Elevation
- Rectangular Column Ways
- Telescope Piping
- Instant Central Controls
- Anti-Friction Elevating Nut
- Massive Machine Beds
- Hydraulic Power Unit
- Wheel Head Slide Wipers
- Automatic Spark-out Control

ALSO SPECIAL ATTACHMENTS

THE THOMPSON GRINDER CO.

Completely Covering all Normal Ranges of Surface Grinding Requirements

SPRINGFIELD, OHIO, U. S. A.

If you want *Fast Grinding!*

Yes Sir . . . if you want fast grinding put Abrasive Company Grinding Wheels on your grinders!

Their fast cutting action results from the careful specification of the grain and grade combination best suited to your work . . . whether it be hogging-off metal or the finest precision grinding.

Give your production a boost . . . with Abrasive Company Grinding Wheels. Complete details are yours for the asking.

AMERICAN DEFENSE COMES FIRST

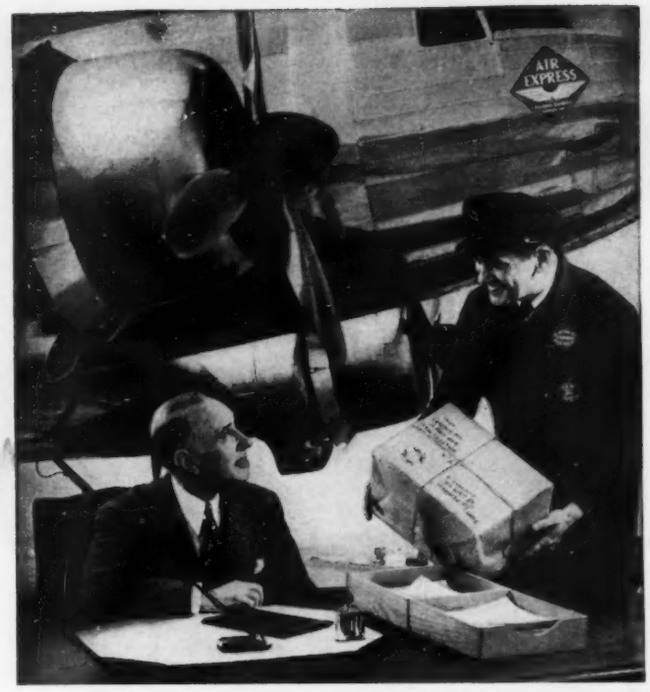
ABRASIVE COMPANY

Division of Simonds Saw and Steel Company, Tacony and Fraley Sts., Philadelphia, Pa.

ELECTRIC FURNACE PLANT: ARVIDA, QUEBEC, CANADA • CHICAGO BRANCH: 127 S. GREEN STREET

DISTRIBUTORS IN ALL PRINCIPAL CITIES

Manufacturers of Abrasive Grinding Wheels under the trade mark names BOROLON (aluminum oxide) and ELECTROLON (silicon carbide)



AIR EXPRESS SERVICE IS SUPER-SWIFT AND DIRECT!...

Right now, mister, you need the quickest, surest shipping service to help cut down on costly production delays. That means Air Express. It's super-swift and direct for anything you have to receive or send in a hurry.

With Air Express... replacements, assembly parts or heavy machinery travel on wings... at 3 miles a minute from airport to airport. And we make *special* pick-up and *special* delivery, right to your shipping department or office, at *no extra charge* within our regular vehicle limits in all cities and principal towns. Foreign as well as U. S. service, and coordinated air-rail connections to off-airline points. For information and service, phone RAILWAY EXPRESS, AIR EXPRESS DIVISION.

'Fastest Way' Means

AIR EXPRESS

MORE FOREMEN NEEDED . . .

This book shows how to get and hold a supervisor's job

As industry speeds up, larger forces mean more foremen . . . Foremen's problems in handling different types of men increase . . . Supervisors will be called on to train more men in operations and policies.

And so on . . . everything adding up to more opportunities, more pay, for men who can handle supervisory positions efficiently.

What about you? Do you want to get a supervisor's job, or make the most of the one you are in? Now, at just the right time to help you, a new book appears . . . a straight-out, practical, quick-study manual of supervision methods that work.

Just Out!

HOW TO SUPERVISE PEOPLE

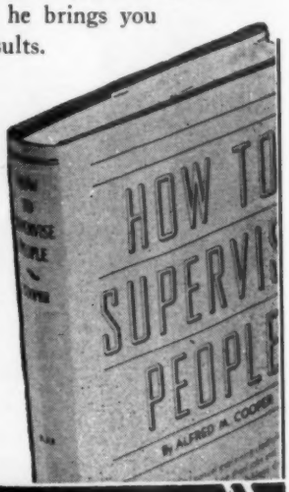
By ALFRED M. COOPER

145 pages, 5 x 7¼, $1.75

Gives you recommended methods of handling situations foremen and executives encounter daily in their work. As educational advisor to many big firms, author has discussed personnel problems with thousands of experienced supervisors; in this book he brings you solutions they agree get best results.

Tells you:

- —how a worker should conduct himself to get in line for a supervisory position
- —how to handle problems of employee health and safety
- —how to keep up the employee's interest in his job, his satisfaction with it, and loyalty to it
- —what qualities the supervisor should develop to make his leadership more effective
- —how to secure the cooperation of subordinates and superiors
- —how to hire and fire
- —how to reprimand
- —what work to delegate to others; how to keep a check on it
- —how to train men, individually or by conference method



MAIL THIS COUPON

McGRAW-HILL ON-APPROVAL COUPON

McGraw-Hill Book Co., Inc., 330 W. 42nd St., N. Y. C.

Send me Cooper—How to Supervise People, for 10 days' examination on approval. In 10 days I will send $1.75, plus few cents postage, or return book postpaid. (We pay postage on orders accompanied by remittance.)

Name .....

Address .....

City and State .....

Position .....

Company .....A. 6-25-41

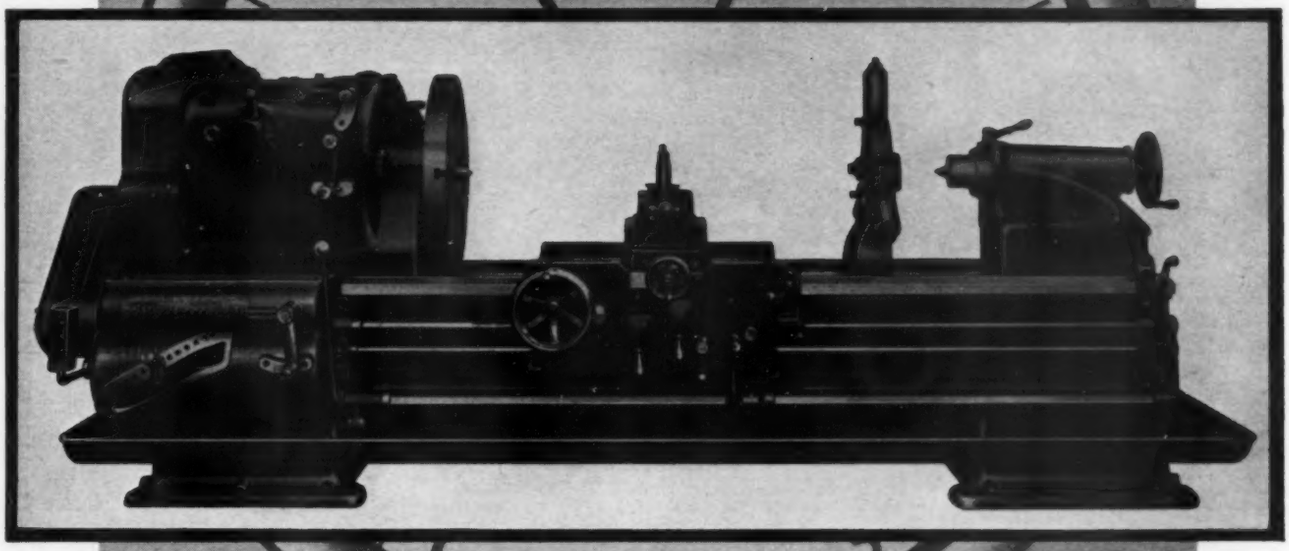
(Books sent on approval in U. S. and Canada only.)

Work twice around the clock

WITH

SPRINGFIELD

GEARED HEAD LATHES



● The current defense program calls on every manufacturer to do his utmost in meeting present day requirements, even if it means working 24 hours a day, seven days a week!

Under these circumstances, then, it's easy to see that your tools will get little, if any rest . . . . that they must produce *accurately, swiftly* and *safely,* without time-off for repairs due to structural faults or breakdowns. Ideal, then, is such a situation for SPRINGFIELD Geared Head Lathes' superior qualities of both construction and design.

Don't hesitate in letting SPRINGFIELD's carry your production load. All along the bed, from headstock to tailstock, they excell in basic materials, gearing arrangements, attachments, lubricating systems and power transmission. Sizes, too, are compppletely varied . . . there's one to meet almost every requirement.

Get this "twice-around-the-clock" service that SPRINGFIELD offers. Make every hour of the day more productive and less costly as to lathe maintenance and upkeep. A letter today will bring complete SPRINGFIELD Geared Head Lathe price and size specifications. Write!

The SPRINGFIELD MACHINE TOOL Co.

SPRINGFIELD OHIO U.S.A.

ARTER ROTARY SURFACE GRINDERS IN ACTION

at Wright

GRINDING CAMS FOR "CYCLONE" ENGINES

PRACTICALLY every job in the manufacture of Wright "Cyclone" Engines is a precision job, and some of the closest tolerances called for are on the jobs being performed on Arter Grinders. Three Model A3 machines—three of the many that are on the job at the Wright plant—are shown grinding faces of cams for "Cyclone" Engines. The work spindle construction, employing selected, precision, double-row, pre-loaded ball bearings, top and bottom, is a constructional detail that insures "aircraft accuracy". The great vertical capacity gives the flexibility needed to grind work directly on the chuck or on fixtures, as in the illustration.

Arter Model A3 Rotary Surface Grinders are made in 12" and 16" sizes. Let us send you detailed specifications of their accuracy and work-producing capacities.

ARTER GRINDING MACHINE COMPANY

15 SAGAMORE ROAD **WORCESTER, MASS.**

Has this ever happened to you?

GEORGE AND HENRY got themselves into this in spite of ample warning which ran something like this: *"Remember now . . . if I hear the word* BUSINESS *tonight, you'll be extremely sorry."*

. . . but it didn't do any good. It never does.

It just so happens that most successful men have their BUSINESS on their minds wherever they go. It gets under their skin like nothing else. It's the most important single thing in their lives.

This fact is quickly recognized by Advertising men . . . and many of them take advantage of it.

They know BUSINESS is the one thing that brings together the golfers, the bridge-players, the mystery-lovers. It's the one interest shared by all men of Management with equal intensity. The one force that makes a powerful, compact *market* out of a certain magazine's *audience!*

Advertising men know that Business Week's unusual strength results from its unusual importance to its readers.

For, there's nothing casual about business news today. Management-men need a 'private wire' to its source . . . need a magazine whose pages are backed with known authority . . . need a publication with the swift pace of weekly regularity.

They get that important service through Business Week. These men who are managing American industries get that kind of business *news* service . . . and one thing more: They get a business *goods* service, not duplicated by any other magazine of any kind.

In the first 5 months of '41, for example, Business Week has displayed nearly as many pages of advertising as all the rest of its field together . . . and shows an issue-by-issue gain of about 27% over its own figures for a year ago!

That's the way the men of Advertising are turning unusual READER-INTEREST to their own advantage. And that's the way many advertisers are getting back 100 cents on every advertising dollar invested.

Has *that* ever happened to you?

Business Week

ACTIVE MANAGEMENT'S MAGAZINE

GRAND RAPIDS
Hand Feed
SURFACE GRINDERS

. . . for extreme accuracy and fine finish on any work within their capacity . . .

Each of these conveniently handled machines is built around a heavy, rigid, properly designed one-piece column and base casting.

The No. 18 machine shown (with a 19" longitudinal table movement, a traverse table movement of 11¼" and a vertical movement of 12") has a spindle belt driven from motor inside base. Front of table is accurately ground square with spindle to permit the use of this surface for setting up work. A Vernier reading of vertical movement is also provided.

When desired this machine can be furnished arranged for wet grinding or with a motor driving exhaust attachment.

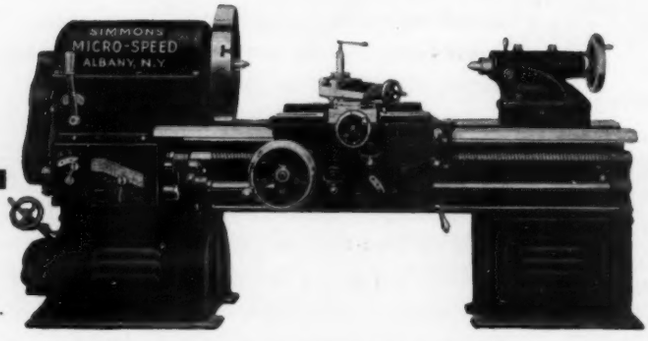
All Grand Rapids Hand Feed Grinding Machines are equipped with finest precision type ball bearing spindles.

Send for our 4 page bulletin featuring Grand Rapids Hand Feed Machines.

GALLMEYER & LIVINGSTON CO.

330 STRAIGHT AVE., S.W. GRAND RAPIDS, MICHIGAN

SIMMONS *Micro-Speed*
Reg. U. S. Pat. Off.
LATHES



Illustrated above is the 18" and 20" Heavy Duty Lathe.

Simmons Lathes with *Micro-Speed Drive* are manufactured in 16", 18" and 20" standard, 16"/25", 18"/27", 22"/34", 20"/40", 26"/40" and 28"/50" gap beds—in all bed lengths.

We will be glad to send complete specifications upon request.

THE new Simmons Lathes feature the *Micro-Speed Drive*, an important fast-production asset. This Drive, contained in the cabinet leg, permits instant selection of an infinite variety of spindle speeds by a mere turn of a hand wheel.

In all other respects, the Simmons Lathes are of conventional design and include Timken Precision Tapered Roller Bearings, Snap levers for apron feeds and added efficiency under heavy loads.

SIMMONS MACHINE TOOL CORP.

Main Office: 1759 N. Broadway, Albany, N. Y. **New York Office: 149 Broadway**

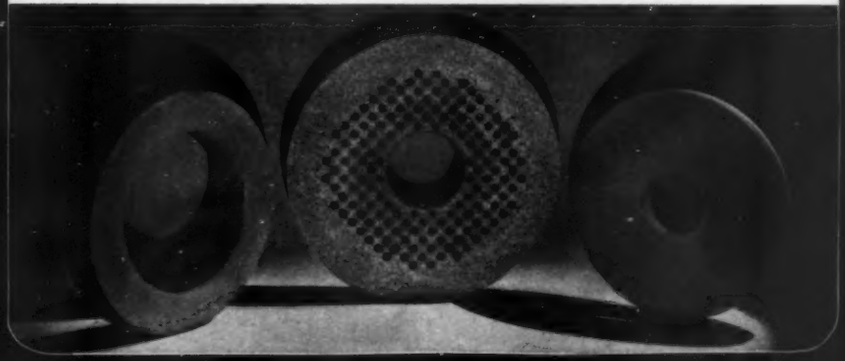
When 41,000,000 CUTTING POINTS Go to work!

THAT'S actually what happens when the wheel of an average-size Gardner Disc Grinder, starts revolving at a surface speed of a mile-a-minute, and "goes to town" on those flat surface jobs of yours.

No exaggeration! In a 30"x6"x2" thick GARDNER WIRE-LOKT ABRASIVE DISC, there are as many as 41,000,000 individual abrasive grains; sharp, flint-like grains, whose keen cutting points, forced into contact with your work, shear away the toughest stock as though it were chalk.

And when these 41,000,000 cutting points go to work for YOU, down go your grinding costs! That statement can't be proved until you try a Gardner WIRE-LOKT Disc, but in support of it, we offer the evidence of more than 4,000 satisfied users; users on all types of work, whether the toughest metals, or hard rubber; whether asbestos composition, or terra cotta.

Write for our 16-page Abrasive Booklet!



GARDNER MACHINE COMPANY

410 East Gardner Street, Beloit, Wisconsin, U. S. A.

Vitrified

Cuts longer between turns

Vitrified Grinding Wheels assure economy in high quantity production fine precision grinding because they cut longer between each wheel truing. Then, too, these long life, strong wheels require less redressing. They can also be depended on to eliminate gumming, glazing and heating.

All these advantages are available regardless of the grinding job, because there is a size, shape and type Vitrified Grinding Wheel for every grinding purpose. The completeness of the Vitrified line makes it possible for any shop to standardize on Vitrified Wheels.

Our engineers will gladly study your grinding operations and point out the savings you can make through the use of Vitrified Wheels.

BORITE—for all kinds and classes of steel grinding.

CARBORITE—for all classes of cast iron, brass, bronze and aluminum grinding.

Also, Silicate, Shellac and Resinoid Bonded Wheels.

VITRIFIED

VITRIFIED WHEEL COMPANY
WESTFIELD MASS.

—SPECIAL FEATURES—
1 — LOW HUNG DRIVE TO THE SPINDLE 2 — ALL POWER DRIVEN PARTS RUNNING IN OIL 3 — QUIET RUNNING AT ALL SPEEDS 4 — CONCENTRATED AND CONVENIENT CONTROLS 5 — CONSTRUCTED ON UNIT PRINCIPLE

The CARLTON
MACHINE TOOL COMPANY
CINCINNATI, OHIO, U.S.A.

NILES
The NILES TOOL WORKS CO.

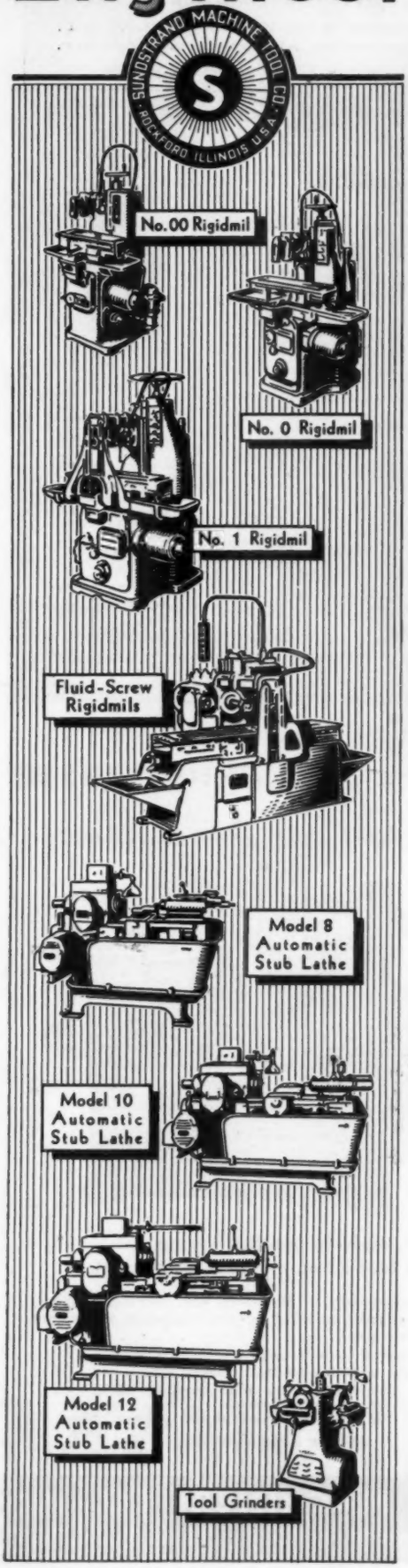
Time Saver TOOLS

PUTNAM
The PUTNAM MACHINE CO.

Divisions of GENERAL MACHINERY CORPORATION Hamilton, Ohio

OFFICES IN ALL PRINCIPAL CITIES

Engineered Production...



★ When you want greater output on milling and turning, use Sundstrand Engineered Production. This service develops for you the best applications of unique qualities which make Sundstrand Rigidmils and Stub Lathes highly efficient, adaptable, and economical.

For Example . . . The milling job shown above was formerly done in two separate hand-feed operations of form milling and slotting. Now the two operations are combined, and duplicate fixtures at opposite ends of the Rigidmil table are used. The 2-way automatic hydraulic table cycle may run continuously, as diagrammed; or stop at any point as required. Production is more than doubled, labor and work-handling are reduced more than half . . . and 100 other milling operations are also handled on this Rigidmil.

At Your Service . . . Engineered Production data and experience, acquired in developing hundreds of highly successful Rigidmil and Stub Lathe installations are at your service for saving time and labor on milling and turning. Get your official priority, use Sundstrand Engineered Production, and place your orders *now*.

SUNDSTRAND MACHINE TOOL CO.
2533 Eleventh Street, Rockford, Illinois, U. S. A.

RIGIDMILS • STUB LATHES

Hydraulic Operating Equipment — Centering Machines — Tool Grinders

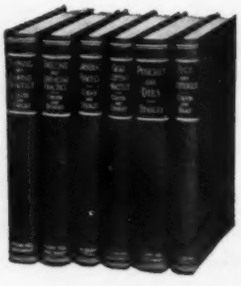
Increased production means more jobs for Machinists

—and MORE PAY for men who know their work!

THIS home-study course gives you the facts on modern machine shop practice, new machines, up-to-date methods—a complete, practical training course—that you can use to improve your skill and advance your earning power now.

AMERICAN MACHINISTS' LIBRARY

6 Volumes, 2368 pages, 2516 illustrations, many charts and tables



THESE books answer your questions on methods and machines—tell what you need to know about the operation of machines of all types and sizes for the whole range of metal cutting, forming, and finishing operations — show by text, diagram, and illustration the essential points of setting up work, adjusting machines, selecting feeds and speeds, determining pressures, handling materials, devising short-cuts, etc.

What the Library gives you: description of all important varieties of machines, both manual and automatic; data on speeds and feeds, new cutting alloys and materials; practical information on grinding machines and abrasive wheels; exact, descriptive data on all aspects of gear-cutting practice;—the gist of more experience than any one man could amass in a lifetime of work.

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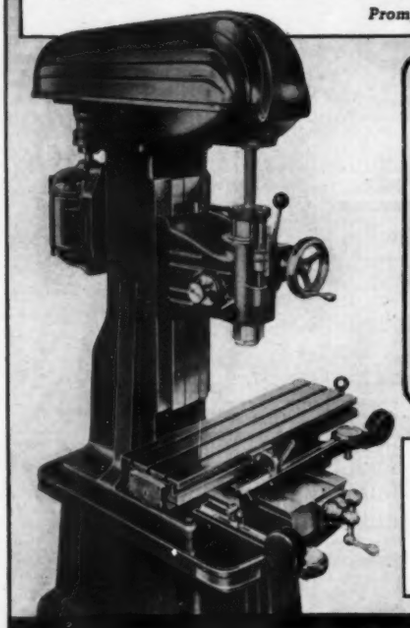

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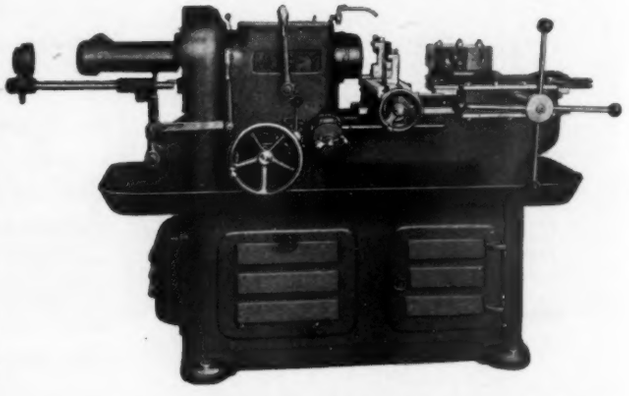

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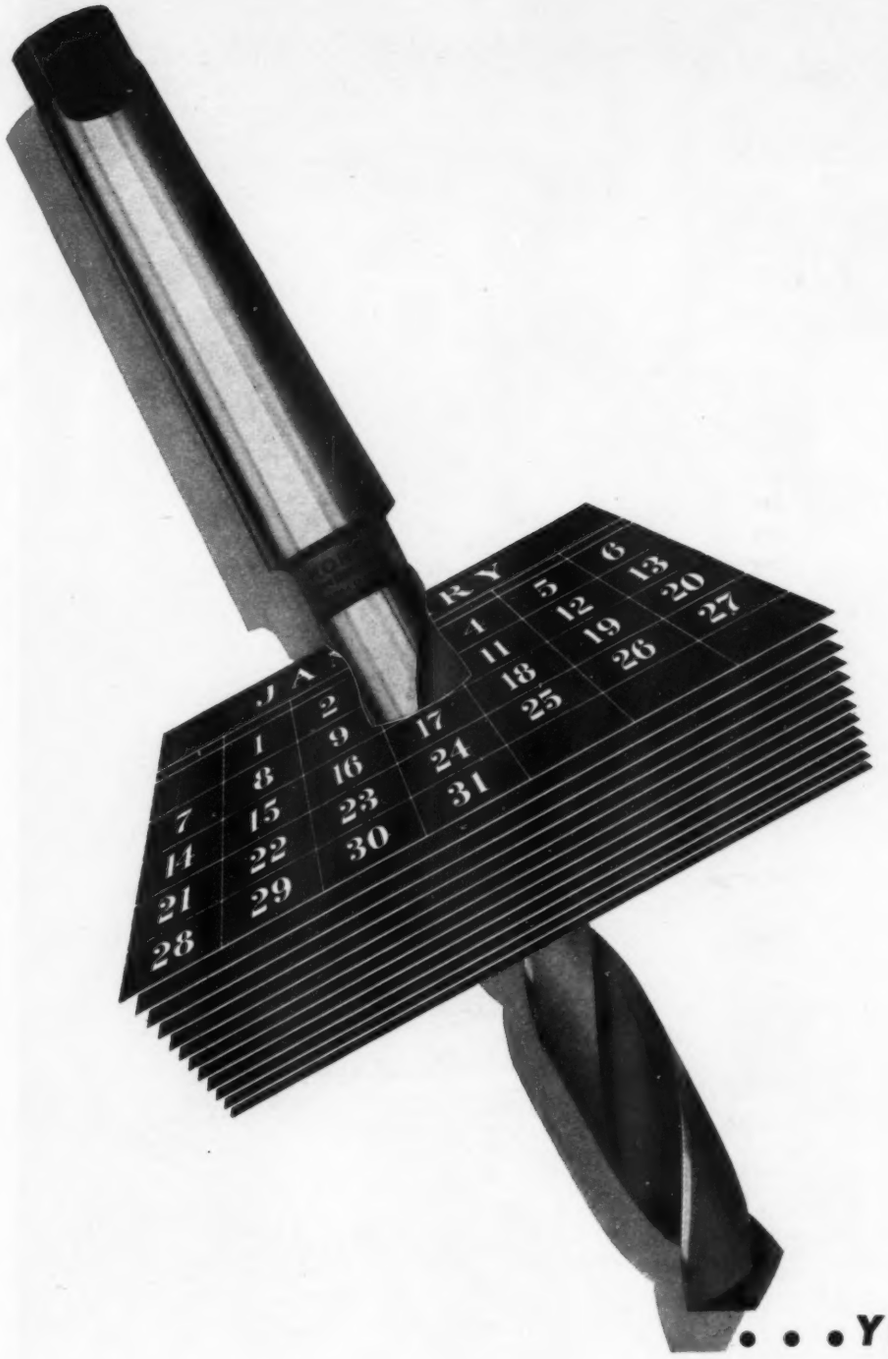

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constant improvement of Morse Drills has more than kept pace with the constant increase of production-machine capacities. As always, "There IS A Difference."

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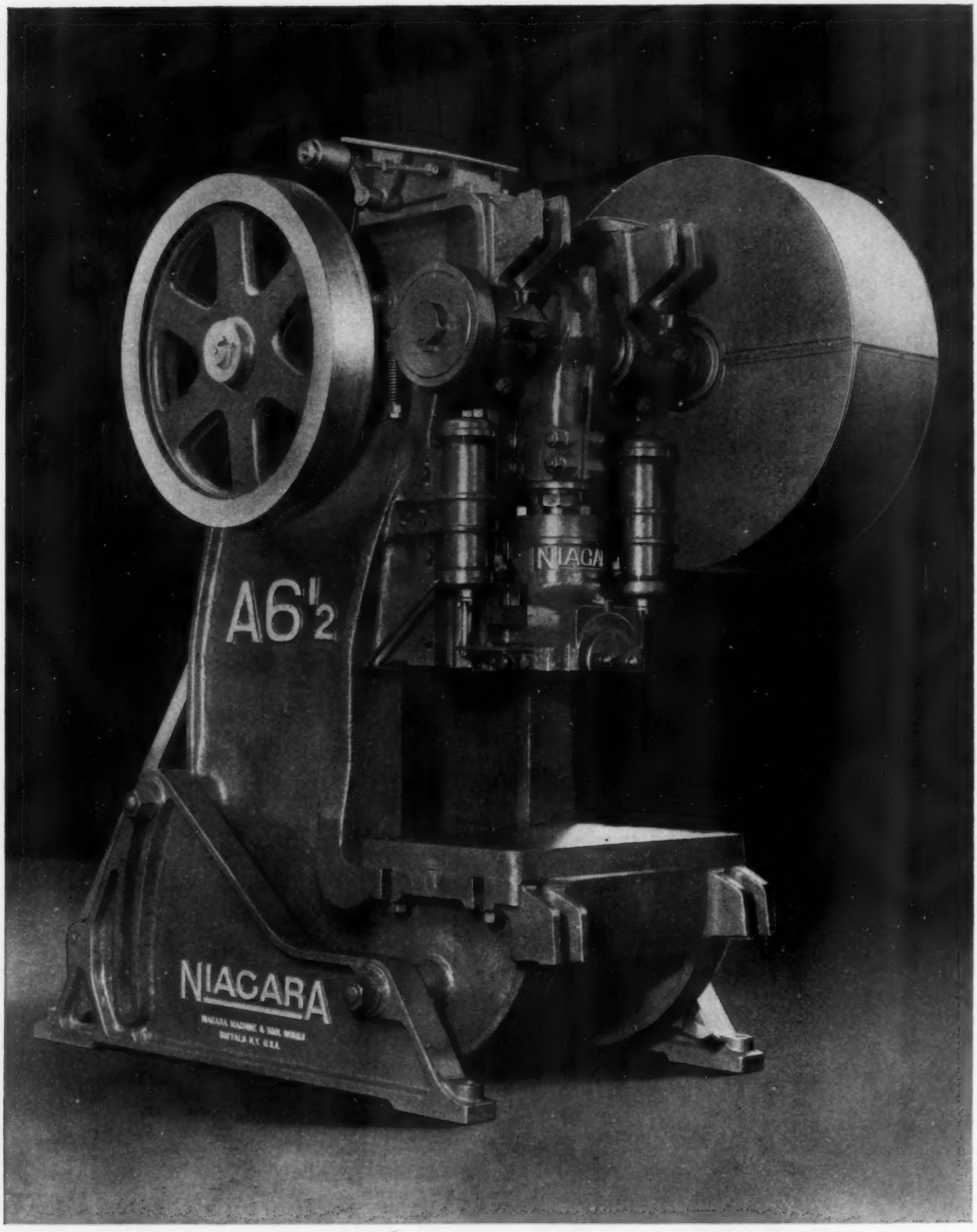
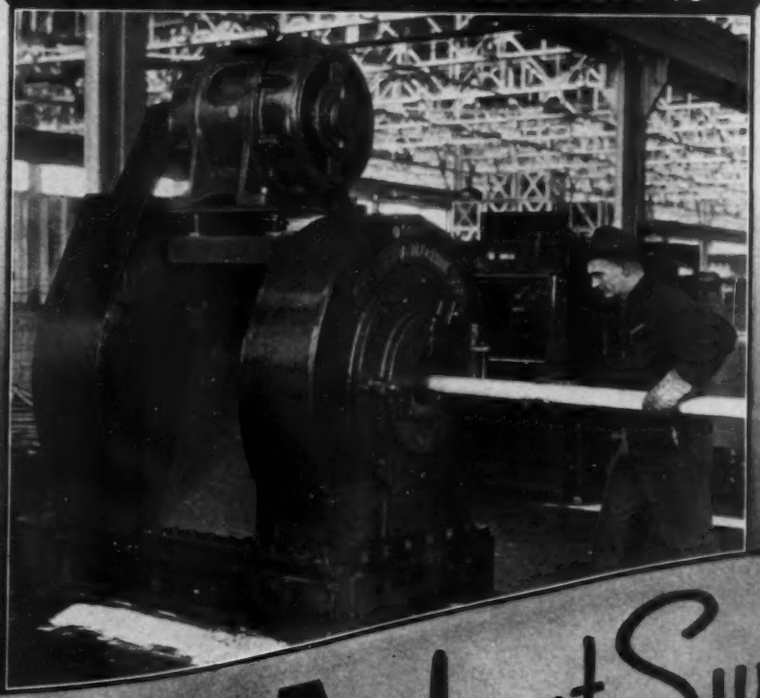


America's foremost industries including aircraft, automotive, electrical and many others are speeding up production with Niagara Series "A" Open Back Inclinable Presses. The Press shown above is one of the complete line built in capacities from 7 to 190 tons. Specifications are given in Bulletin 58 available upon request. Niagara Machine & Tool Works, 637 Northland Ave., Buffalo, N. Y. Branches: Cleveland, Detroit, and New York.

This New Plant ..... DETERMINED TO SAVE TIME IN THE PRODUCTION OF VITAL MATERIALS ... *decided to*



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● Recently installed in a new plant given over almost exclusively to defense manufacturing, this new ETNA is doing its share in the "all-out activities" for speedy, accurate defense output. The operation illustrated is tube pointing prior to drawing . . . a "natural" for ETNA's efficient, time-saving qualities. For, as this company well knows from past ETNA experience, swaging is the most economical method of giving a tube a smooth, clean and open point. Have you a problem involving the tapering, sizing or reducing of round solids and tubing? It will pay you to consult ETNA about swaging. ETNA Swaging Machines come in capacities of 3/8" to 4", with die lengths of 1" to 18". If you're working on defense projects, where precision work in volume lots, at lower cost, must be had,—"Ask ETNA About Swaging".

IF IT'S A QUESTION OF TAPERING, SIZING OR REDUCING OF ROUND SOLIDS OR TUBING ...
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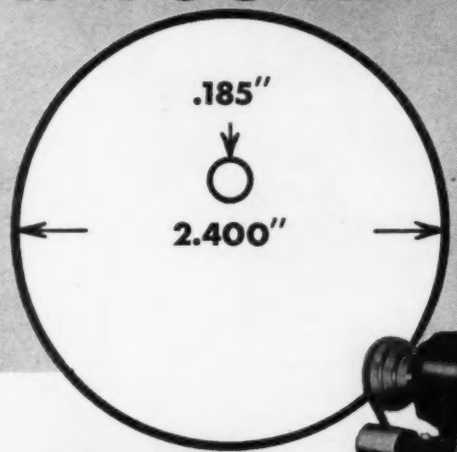
IF YOU HAVE A JOB REQUIRING



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Drawing and Blanking Die "Saves time in producing smooth base metal finish."

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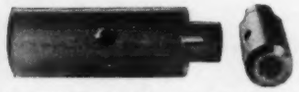
"Produced an extremely accurate and glass-like finish."



Diesel Engine Fuel Injector Cylinder "So accurate that a piston can be fit within .00005 inch."

"A perfectly straight round hole with a mirror finish."

YOU CAN SOLVE FIVE IMPORTANT PROBLEMS with the

SUNNEN 4-SPEED PRECISION HONING MACHINE

Throughout the metal working industries, especially on defense jobs ranging from airplanes to steam turbines, hundreds of manufacturers have found the answer to increased production with greater accuracy and lower costs in this practical, inexpensive machine—because it:

1. Corrects errors of out-of-roundness and taper produced by previous operations
2. Produces super-smooth surface finishes
3. Finishes holes to close tolerances both as to size and straightness
4. Maintains alignment established by previous operation
5. Provides simple, low cost production method of duplicating sizes accurately

and here's the best news of all! You don't need a skilled machinist to operate the Sunnen Precision Honing Machine! Any intelligent workman with a few hours' practice can produce super-smooth finishes and hold accuracy within .0001".

Can be set up and work located in less than one minute!

If you have an internal sizing or finishing operation within the range of the Sunnen Precision Honing Machine it will pay you to write at once for new 8-page bulletin — or, if you prefer, a sales engineer will be glad to call and demonstrate in your plant on your job just what this machine can do for you.

SUNNEN PRODUCTS CO. 7941 Manchester Ave., St. Louis, Mo.
Canadian Factory, Chatham, Ontario

Call on

KENT-OWENS

for Milling Machines

On today's tough jobs . . . and every day when you want ***rugged, simple, efficient,*** milling machines . . . call on Kent-Owens. With the many practical features of these machines, experienced shop men find they are better able to meet priorities with faster production. Write for bulletins . . . Kent-Owens Machine Company, Toledo, Ohio.

Here at last **is an OUTSTANDING high-production COLD METAL SAWING MACHINE—**

Cuts stock from 3 inches up—Handles multiple cutting of small bars or shapes . . . . . .

The outstanding high capacity and speed of this new 8" Porter-McLeod machine—for general work or for production work in single or multiple units—are attained through modern, unique features of design which assure faster, cleaner, more accurate cutting.

Upper feed of the machine permits "nesting" of economical quantities of bars or shapes using our systems of multiple or interchangeable "nests" which give support to each nest on both sides and bottom.

To insure accuracy and protect against blade damage at times when hard spots are encountered in cutting, friction disc feed is provided. Further protection is assured and weaving and buckling prevented by supporting the blade close up to its rim and by *pulling the blades upward through* the cut. This method of feed and drive also results in lower power requirements and straight cuts under all conditions.

Standard feed is 3 inches per minute. This, however, can be stepped up for cutting such materials as brass or other non-ferrous metals.

Investigate the Porter-McLeod Production Cutting-Off Machine Today. Details available promptly on request.

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YOU GET MORE FOR YOUR MONEY WITH UNIVERSAL DRILL BUSHINGS

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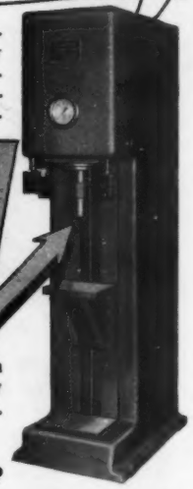
NEW DENISON *Knee-Type* HYDRAULIC PRESS

Want faster production on small-lot assembling? Here's the press for it!—the new DLKC2, one of Denison's line of 2- to 100-ton-capacity hydraulic presses for assembling, straightening, broaching. 24" maximum stroke; 30" vertical opening; both hand and foot controls for ram—manually or electrically operated. A versatile press. Easily modified. Write for details today!



QUICK RETOOLING CUTS PRODUCTION COSTS!
Time-loss is reduced to the absolute minimum on small-lot pressing operations that call for frequent changing of tools, bolsters, fixtures or supports!

NEED SPECIAL MACHINERY?
Denison designs and builds all types of special hydraulic presses and other machinery. They have every facility with which to fill *your* needs. Consult Denison's widely experienced engineers! Submit your problems without obligation.

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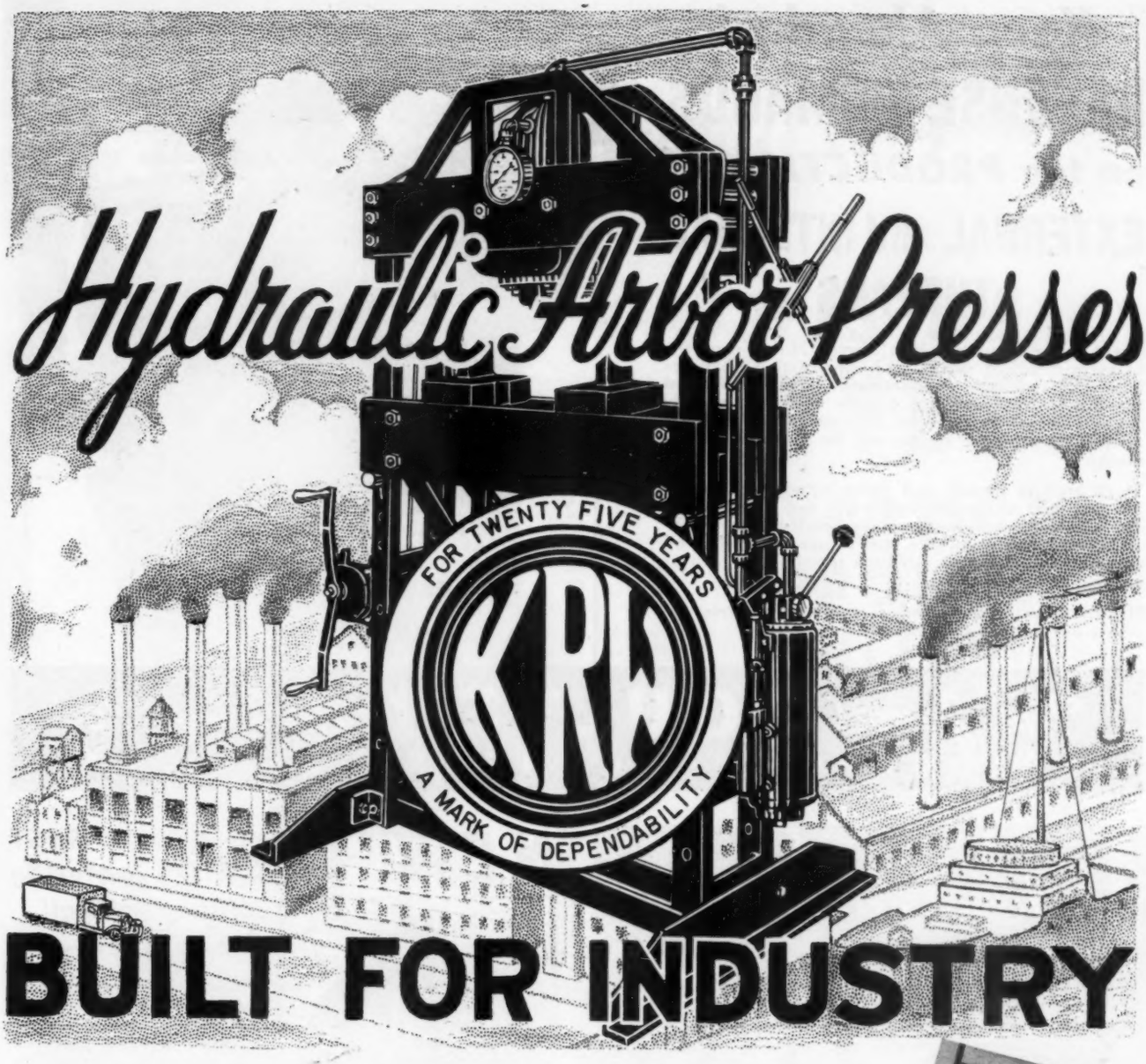

KRW Hydraulic Arbor Presses meet industry's demand for SPEED. Speed in getting the ram to the work—Speed in developing required tonnage pressure —Speed in raising the ram to remove the work.

Send for your copy of the new 16-page bulletin describing in detail the NEW 2 Speed Pump—the Lever Controlled Valve that opens or closes with a flip of the Ball Arm—and many other patented features found only on KRW Presses.

Built in 25, 50 and 75 ton sizes. Prices start as low as $180.00. Compare before you buy.

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Please send Hydraulic Arbor Press Bulletin No. 38.

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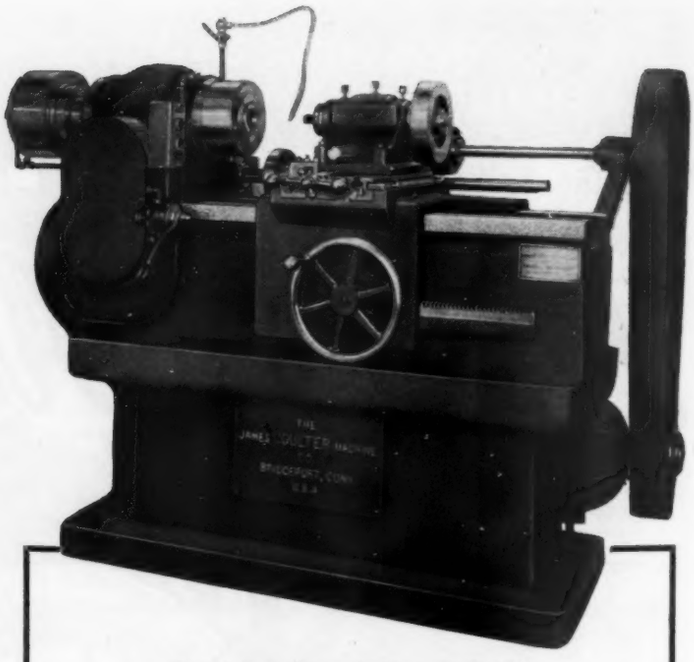
Keep Ahead of
DEFENSE DEMANDS
on the PRODUCTION of
EXTERNAL and INTERNAL THREADS

The Coulter Type "H" Hob Thread Miller—modern in every detail of design and construction—handles high speed, accurate production of right or left hand threads. Any parts that can be held in ordinary chucks, air operated chucks, air operated collet chuck or special face plate fixture can be threaded on this machine.

Work holding spindle and cutter spindle are driven by individual motors through worm and gears. Speed changes to work spindle are accomplished by pick-off gears; cutter spindle speeds are controlled by variable motor sheave. All high speed shafts turn in anti-friction bearings.

Maximum external thread, 7"; minimum hole depends on smallest hob practical.



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4 JAW INDEPENDENT L-W LATHE CHUCKS

Semi-Steel body, ribbed construction, hardened and ground steel reversible jaws—Made to stand the gaff. We are proud to offer such Hi-quality at low cost.

10" Size	$32.00
12" Size	36.50
14" Size	41.50
16" Size	53.50
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NEW! THE G S DIAL TEST INDICATOR featuring *Universal Ball Joint Back—*

A simple movement takes the place of the usual rotating multiple gear and pinion trains. Friction is minimized, thereby assuring greater accuracy, and less chance of error. Fewer parts mean less wear, trouble and repairs.

The new "GS" is built for long service and maintained accuracy under hard usage. Write for complete details today.

UNIVERSAL BACK for Greater Convenience

This feature permits a wide range of indicator settings. Indicator may be clamped in any desired position. Inaccessible work easily reached.

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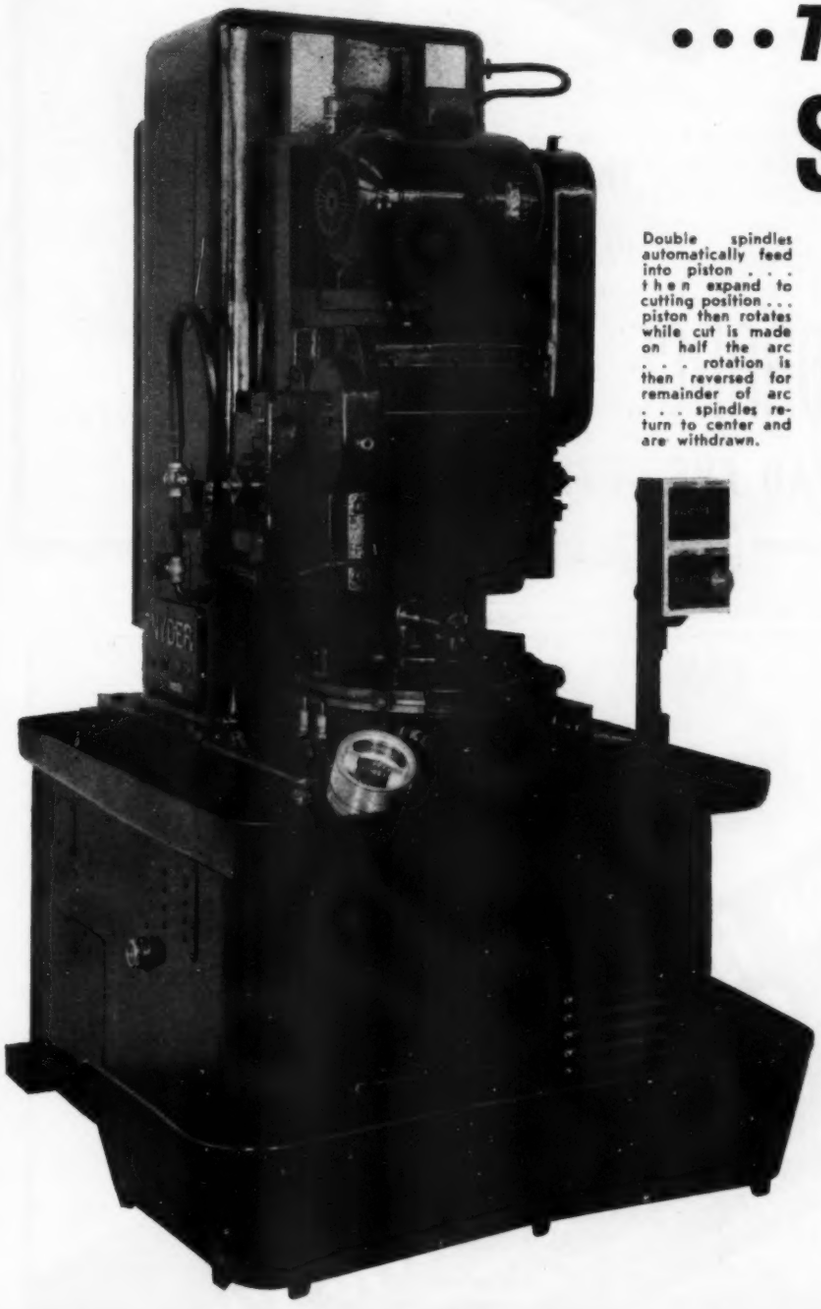
Building Better Aircraft Engines...



Double spindles automatically feed into piston . . . then expand to cutting position . . . piston then rotates while cut is made on half the arc . . . rotation is then reversed for remainder of arc . . . spindles return to center and are withdrawn.

...THIS NEW SNYDER VERTICAL PROFILE MILLER!

● *Quality* production in *quantity* lots is truly exemplified by this new, *special* machine, designed and developed by Snyder to bring speedy output at low cost to the aircraft engine industry.

This new unit mills, to very accurate limits, the inside pocket and fins on pistons for aircraft engines. The production is 20 pistons per hour per machine, with one man operating two units, as the cycle is completely automatic.

Here, then, is another example of Snyder's wide range of machines conceived and built by our highly trained engineering department . . . built to serve your exact needs *better, faster, and at lower cost.* Our services are yours to use wherever and whenever a production problem exists. May we help you?

FOR INCREASED OUTPUT, AT LOWER COST . . .

See Snyder Before You Plan Production Set-Ups!

SNYDER TOOL & ENGINEERING CO.

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WILLARD SPRING TOOL HOLDERS

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PERMANENT MAGNET TYPE No wires — No heating — No running costs
Ask for circular describing the complete line of Rectangular and Rotary models.
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For sale only in the U. S. A. and its Territories
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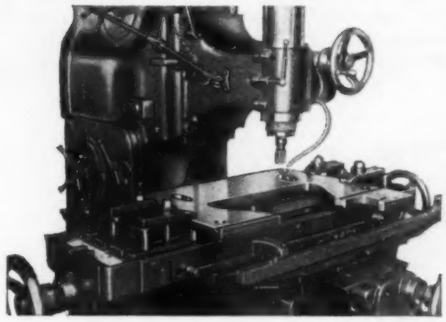
Rectangular Model
5"x10" 6"x18"
8"x24" 12"x36"
Rotary Model
working face
—9" diameter

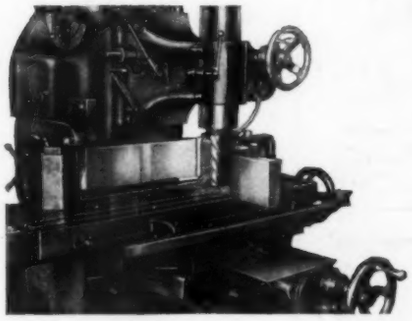
Balanced design makes KNIGHT Millers *adaptable to wide variety of work . .*



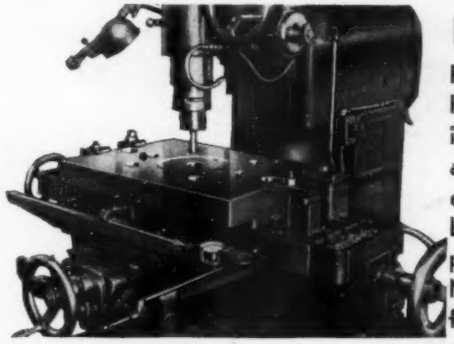
EXAMPLE 1.

LIGHTMILLING: Many operations were performed on the large one-inch steel plate at one setting, including profiling, milling, boring, slotting, and keyway cutting. KNIGHT Miller's wide range of spindle speeds, solid table unit, and ease of handling provide efficient production and accurate results on all of these operations.

EXAMPLE 2.



HEAVYMILLING: A two-inch diameter cutter, six inches long, was used on large forging to remove as much as five-sixteenths inch of stock in some places without appreciable spindle deflection. The forging was machined completely all over and met with rigid inspection for finish and tolerances. You can do tough jobs like this with your KNIGHT Miller.



EXAMPLE 3.

PRECISION BORING: Here a KNIGHT Miller is successfully handling a boring job on an eighteen inch by twenty-nine inch plate, two inches thick. Nine holes, ranging from one and one-eighth inches to two inches in diameter, were accurately bored to limits of plus or minus .0005". Dial indicators for quick and accurate locating, a large accurately fitted spindle to insure round and straight holes, and table slides that are square, make the KNIGHT Miller ideal for this work.

Read complete details on Balanced Design and other* KNIGHT Miller *features in new catalog

RIGIDITY: Firmness that insures high standards of workmanship and production volume.

ACCURACY: The result of design as well as precision of workmanship and the quality of materials used.

VERSATILITY: Capabilities which greatly simplify many set-ups that would otherwise be difficult to obtain.

ACCESSIBILITY: From either a sitting or standing position, the operator always has a clear vision of the job—one set of simple, convenient directional controls, for both hand and power operation, within easy reach.

CAPACITY: Sixteen changes in speed, in either direction, give the spindle ample range to meet a wide variety of requirements.

PRECISION BORING: KNIGHT Millers have the necessary requirements for precision boring of jigs and fixtures, and for accurately locating and boring on a production basis where it is not economical to make special tools.

Write for New Catalog NOW - -

W. B. KNIGHT MACHINERY CO.
• ST. LOUIS, MISSOURI •

Let us Check your Gage Blocks

JOHANSSON GAGE BLOCKS are vital to defense production. They should be verified frequently, just as your inspector checks his micrometers.

It is just possible that wear or injury to which your Gage Blocks are subjected may impair their accuracy and reflect on your product. You can take a simple precaution, and fully safeguard your precision through our inspection facilities, which are available at quite nominal charge.

Write or phone for particulars.

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JOHANSSON GAGE BLOCKS

TUNGSTEN CARBIDE TIPPED TOOLS

Price $1.00 Each In Any Size

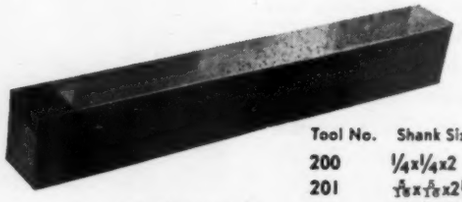
New Low Prices — Increase Production — Cut Operating Costs

Tools are tipped with Tungsten Carbide, and are suitable for machining cast-iron, brass, bronze, aluminum, non-ferrous materials such as hard rubber, bakelite, fibre, and tough alloy steels up to 500 Brinell hardness

Left Hand-Reverse Image. Right Hand Shown

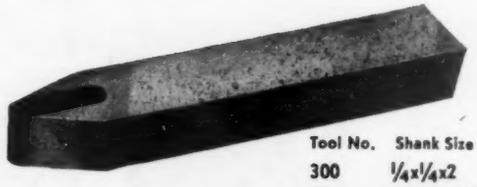
SERIES 100

Tool No. RH	LH	Shank Size
R-100	L-100	1/4x1/4x2
R-101	L-102	5/16x5/16x2 1/4
R-103	L-104	3/8x3/8x2 1/2
R-105	L-106	7/16x7/16x3
R-107	L-108	1/2x1/2x3 1/2



SERIES 200

Tool No.	Shank Size
200	1/4x1/4x2
201	5/16x5/16x2 1/4
202	3/8x3/8x2 1/2
203	7/16x7/16x3
204	1/2x1/2x3 1/2



SERIES 300

Tool No.	Shank Size
300	1/4x1/4x2
301	5/16x5/16x2 1/2
302	3/8x3/8x2 1/2
303	1/2x1/2x3 1/2

Standard Tungsten Carbide Tipped Tool Bits

In lots of 12 assorted in any Series; 100-200-300 Series an extra 10% will be allowed; also in lots of 50 assorted 20% discount will be allowed.

Sizes not listed as well as special TIPPED TOOLS will be quoted upon request. When ordering, state tool number and quantity desired.

WE CARRY SILICON CARBIDE EMERY WHEELS FOR GRINDING TUNGSTEN CARBIDE TOOL BITS

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PRODUCTION SAWS GET THE *First Call* IN EMERGENCIES!

Today's need is speed—and speed begins *at the saw* with the first cut of the metal!

Production men all over the nation are depending on Peerless Power Saws to help them to meet heavy work schedules —to speed up metal cutting—to release skilled men for machining, forging, drilling and assembly operations

These men know what Peerless engineers have contributed to high speed, accurate metal cutting—by the introduction or the first blade coolant system to a Power Saw just before the break of World War-1—and again, in response to the demand for faster cutting in modern alloys within the last decade, by the development of the Patented Four-Sided Saw Frame and Backing-Plate Blade-Support, which made practical the first HIGH-SPEED Steel Blade.

And now, as a further contribution, the Peerless High Duty line is available with Full-Automatic, Hydraulic control—providing a full automatic cycle in fast, accurate metal cutting. Detailed specifications on request.

PEERLESS MACHINE COMPANY
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Peerless
METAL SAWING MACHINES

KENNAMETAL *leads...*

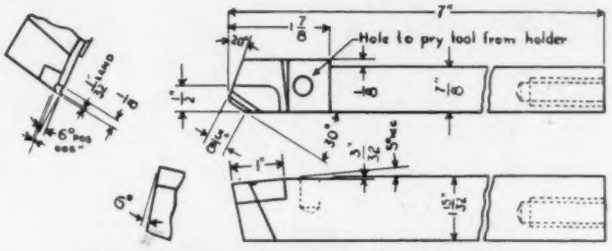
IN CARBIDE TOOL PERFORMANCE

TURNS MORE PIECES PER GRIND
REDUCES MACHINING TIME
when Rough Turning 75 mm Shells

The superiority of KENNAMETAL over other steel cutting carbides is revealed not only in laboratory tests but also in performance records from jobs in actual production. Note in the table below how KENNAMETAL increased the number of pieces per grind and decreased the floor to floor time when rough turning X1340 shell forgings:

	KENNAMETAL Grade KH	Carbide "A"	Carbide "B"
Pieces per grind	390 – 600	300 – 400	264
Floor to floor time	50 seconds	66 seconds	70 seconds

KENNAMETAL was able to turn off more metal per tool grind because tungsten-titanium carbide (the principal ingredient of KENNAMETAL) is the hardest carbide known. The decrease in machining time is accounted for by the fact that KENNAMETAL is *stronger* than other tool carbides—hence can be used at heavier feeds.



Modified Style No. 3 KENNAMETAL tool, used at 275 ft. per min., .026" feed, and ⅛—¼" depth of cut for rough turning shell forgings. Three tools, turning simultaneously, were used.

Deliveries of standard KENNAMETAL tips are now being made within three to four days upon receipt of order; deliveries of standard and Modified standard tools within ten days (except for unusually large orders involving thousands of tools). Our plant expansion program will soon make it possible to substantially shorten this delivery time.

Write for Catalog No. 41

CANADIAN AGENT: Kennametal Tools & Mfg. Co., Ltd., 24 Dunbar Ave., Hamilton, Ont.

ERRINGTON

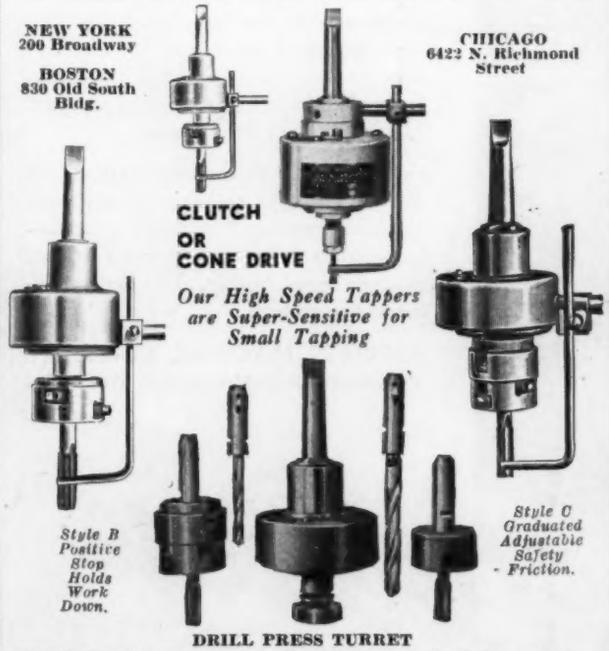
Main Office and Works, Stapleton, Staten Island, N. Y.

TAPPING CHUCKS

NEW YORK
200 Broadway

BOSTON
830 Old South Bldg.

CHICAGO
6422 N. Richmond Street


CLUTCH
OR
CONE DRIVE
Our High Speed Tappers are Super-Sensitive for Small Tapping
Style B Positive Stop Holds Work Down.
Style C Graduated Adjustable Safety - Friction.

DRILL PRESS TURRET

Style D-E with Quick-Change Tool Holders to Drill, Tap and Set studs, etc., without moving work, or stopping or reversing machine. Individual friction adjustments in each tap-holder, if required.

Also, Opening Die-Heads; Opening Stud-Setters; Friction Screw-Drivers and Nut-Setters, etc.

"Green" operators gage accurately to fractions of .0001" using COMTORPLUG

A patented expanding internal gage, giving AUTOMATIC ACCURACY. Self-aligning and self-centering. 2-point gaging. Not a passing reading. Shows actual size in fractions of .0001"; also detects back or front taper, out-of-round, bell mouth, barrel shape, etc.

Widely used by operators and inspectors on airplane, ordnance and industrial work.

Made in sizes from ¼" to 7" diameter and larger, Comtorplug is used whenever precision bores are required: Ball bearing housings; propeller stud holes; wrist pin holes; etc., etc. Its use by machine operators as well as inspectors permits close teamwork for improved bores, fewer rejects, faster assembly. Makes every man in your shop "Master of Ten-thousandths"!

REQUEST BULLETIN 27

THE COMTOR CO. EST. 1928

68 Rumford Ave. Waltham, Mass.

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5 To avoid unfair competition.

6 To determine what is the highest and largest function of the field which he serves, and then to strive in every legitimate way to promote that function.

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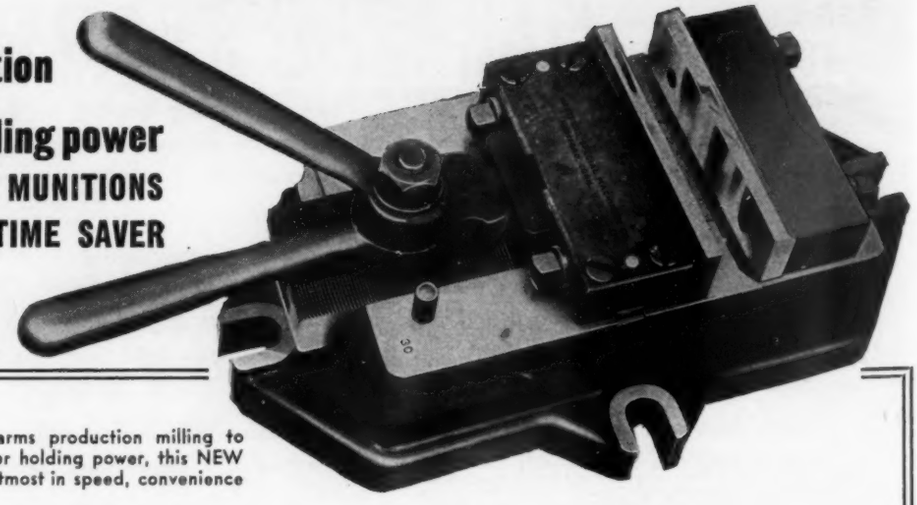
AMERICAN MACHINIST

Member of The Associated Business Papers • Inc.

QUICK—in action
GREAT—in holding power
THE NEW "HARTFORD" MUNITIONS MILLING VISE IS A BIG TIME SAVER ON SMALL ARMS PRODUCTION



Especially developed for small arms production milling to provide quicker action and greater holding power, this NEW "HARTFORD" VISE assures the utmost in speed, convenience and accuracy.

Quick opening and return as well as tremendous binding force are attained through the two levers clearly shown in illustration. Release of the upper eccentric binding lever and a quarter turn of the lower cam lever opens the movable jaw approximately 7/8"—sufficient for easy chip clearance by brush or air when working on comparatively thin pieces. Instant release of work is also provided for when using false jaws and locating dowel pins.

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Made in Plain and Swivel Jaw Types (Plain Type shown).

Width of jaw—5"

Depth of jaw—1 3/16"

Jaw openings: Plain type 2 5/8"; swivel type 2 1/4"

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The HARTFORD SPECIAL MACHINERY CO., HARTFORD, CONN.

For QUANTITY SHELL PRODUCTION

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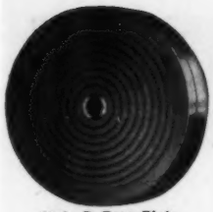

Style D Face Plate, "Concentric Gap" type

WALKER *MAGNETIC* CHUCKS

Where there's a chucking job to be done . . . there's a "WALKER" to do it . . . economically . . . efficiently . . . . . .

Universal Swivelling Magnetic Chuck

Walker Magnetic Chucks—in a complete standard range of types and sizes—are available to cut costs and increase profits on grinding, milling, planing and turning operations. These units are recognized as the "best way to hold most work and the only way to hold some of it."

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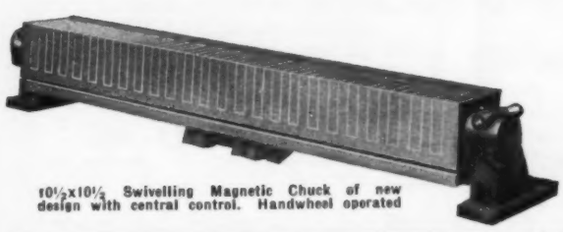
No. 617 Bar Pole Face Rectangular Magnetic Chuck

Special Chucks for special needs

To take care of special requirements, Walker is equipped to render prompt service in furnishing Magnetic Chucks of special design.



10½x10½ Swivelling Magnetic Chuck of new design with central control. Handwheel operated

Use our engineering service

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Because WINTER TAPS are high quality tools they can be depended on to produce more tapped holes of higher accuracy at worth while savings in time and money.

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Division of the National Twist Drill & Tool Co., Detroit, Michigan

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Quality work by skilled mechanics is assured. Send blueprints or samples today!

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We can handle any type of metal spinning including steel. Our modern and complete shop is equipped for speedy production of your work at reasonable rates. For a better job send us your specifications today.

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Put your pattern problems up to us—we will take care of them—ask the foundries about our work—they use our patterns every day.

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BAY CITY FORGE CO.
ERIE PENNSYLVANIA

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AMERICAN MACHINIST
330 W. 42d St. New York

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Send us your RUBBER COVERING problems

Geared to Help You Speed Defense Work!

We rubber cover, to any thickness, all sizes and shapes of metals, plastics and wood for electrical insulation, shock and vibration absorption, and acid resistance. . . . Our formulas meet any specifications for hard vulcanite, semi-hard, or soft spongy finishes.

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Use the new oil resistant, NEOPRENE RUBBER for application on defense projects.

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Metals—Plastics—or Wood.
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Reasonable cost—Does not affect competitive price of your product.

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Tools • Dies • Jigs • Fixtures • Gages

We can handle your precision machine work now. Our modern fully-equipped shop has complete manufacturing facilities for intricate drill jigs, gages, and assembly fixtures to your specifications. Dies designed or built from your blueprints.

We specialize in precision armament work and our facilities can meet early delivery dates. Send your specifications today.

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DEVICES—DESIGNING—
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DIES - TOOLS - FIXTURES

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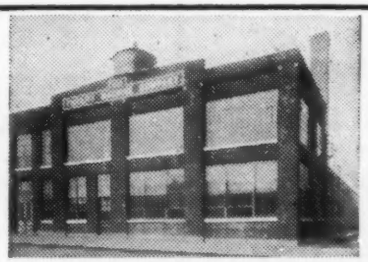

MACHINISTS AND ENGINEERS
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WELL-EQUIPPED TOOL SHOP

Has facilities to boost your production. Tools, dies, special machinery are our specialties. Also facilities for stampings of all kinds. Send blue prints or samples for prompt estimates.

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designers and builders of wire and ribbon stock forming machines.
We also solicit your bids for cam milling

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to your requirements. Contractors for heat-treating equipment, machine tools and stampings. Send us your specifications.

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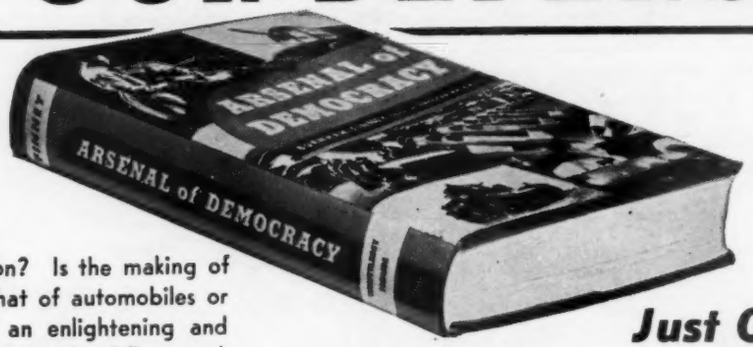
GREY IRON CASTINGS
Up to 60,000 P. S. I. Tensile Strength
and kindred items effectively produced in small quantities—Individual parts to 2,000 pounds—Assemblies to 5,000 pounds.
BROWN & BROWN, INC. Lima, Ohio

HOW INDUSTRY BUILDS OUR DEFENSE

★WHERE ARE THE 50,000 PLANES COMING FROM?



Is America the master of mass production? Is the making of guns, shells, planes, tanks, the same as that of automobiles or washing machines? See this book for an enlightening and exciting view of industrial, business, and scientific skill at work on one of the most gigantic problems that ever faced a nation.

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284 PAGES
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- **how steel will be needed**
- **what the ship-building program involves**
- **how the Office of Production Management is operating**
- **special problems of plane manufacture and the automobile industry's contribution**
- **strategic materials, priorities, financial aspects, mechanized war supplies, etc., etc.**

AS Editor of *American Machinist*, Burnham Finney has been at a vantage point to see, both in detail and at large, the picture of American industry meeting the enormous challenge that has come to it.

Brings you a quick view

Now he simplifies that picture for the busy reader—skillfully giving the necessary background, picking out significant facts, making production details clear, giving the gist of statistics—touching all points to bring you a complete, yet concise and smooth-reading treatment.

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Here is industry's defense story, which is America's too—what is wanted to fill all Democracy's needs as well as America's, the problems involved, and how they are being met—everything from the tooling-up problem to subcontracting, from labor and personnel questions to price control.

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TOOL ROOM JOB LEADERS. For precision tool and die work, several openings. Write stating age, complete experience, present occupation and rate, reason for desiring change. P-70, American Machinist, 330 W. 42nd St., New York, N. Y.

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WANTED IMMEDIATELY: Works Managers, Shop Superintendents, General Foremen, Chief Engineers, Industrial Engineers, Designers and Draftsmen of all kinds at top salaries—All locations. Write for application. Confidential. Established 26 years. Harrison Personnel Service, 20 W. Jackson, Chicago.

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(See also "Selling Opportunities Wanted")

YOUNG MECHANICAL ENGINEER, mechanic, machinist will consider position in South America or Orient. College graduate, unmarried, now employed. PW-80, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

CAPABLE TOOL and machine designer, with executive experience, engineering school graduate, now employed desires permanent position in Eastern Great Lakes Region. Family man in early thirties. PW-81, American Machinist, 330 W. 42nd St., New York, N. Y.

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Machine Shop For Sale
Fully equipped; operating; general machine-tool die some defense work; new building 50x120; large lot; established eighteen years; health compels sale. (Other shop-plants employing ten to three hundred all in operation.) The Apple Industrial Brokers, Established 1905, Cleveland, Ohio.

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We want sales representatives to sell "Quadruplex" Tailstock Turrets and "Quadruplex" Apron Stops in machine shops and other metal working establishments. "Quadruplexes" are excellent sellers for salesmen handling light and medium machine tools, or small tools and accessories. State territory desired and give general description of field covered. Specialites Manufacturing Company, Inc., 35 Farrand Street, Bloomfield, New Jersey.

SALESMAN WANTED to sell improved machine tool on commission basis. Tietzmann Engineering Co., 1043 Highland Ave., Dayton, Ohio.

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Building Suitable For Sub-Contract Manufacturing or Sub-Assembly

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8 ACRES OF LAND with frontage on a main highway and Christiana River and with riparian rights on the river. Suitable for oil tank farm, or manufacturing purposes. Centrally located. Wilmington, Del.

50 ACRES OF LAND with 1100 feet frontage on the Indiana Harbor Canal, and 2000 ft. frontage on Dickey Road. Rail and water transportation facilities. East Chicago, Indiana.

MILL BUILDING, containing 22,500 sq. ft. of floor space, on a tract of about 8 acres of land. Railway facilities adjoining. Ample housing facilities nearby. Pa. *For detailed information or an appointment to inspect these properties, write*

BO-996, American Machinist
330 W. 42nd St., New York City

PROFESSIONAL SERVICES

Machine Tool Designing Engineers

30 Years Experience in Designing, Building & Developing Production Machinery & Processing Operations

Automotive — Tractor
Airplane — Munitions

1115 E. 35 St., Indianapolis, Indiana

W. K. Millholland Machinery Co.

ENGINEERED REBUILDING for DEFENSE

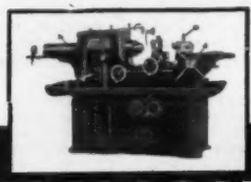
"OUR problem is to see to it that there is no idle critical machine in the United States. The goal should be to work these machines twenty-four hours a day and seven days a week, relieving the machines only for such time as is required for overhauling and repair."

—From President Roosevelt's letter to the Office of Production Management.

SIMMONS can help you make the most of what you have. Our plants are working 24 hours a day returning vital machine tools to the production line. Send us your problem.

FOR QUICK DELIVERY

- 120" x 96" x 25' DETRICK & HARVEY Convertible Openside Planer, reversing M.D., 3 heads.
- 36" x 48' BRIDGEFORD Geared Head Lathe, New.
- 30" x 12' LODGE & SHIPLEY Selective G. H. Lathe, S.P.D.
- 27" x 12' LeBLOND H.D. G.H. Lathe, D.C. Motor & Control.
- 600, 1100, 1500, 2000 and 2500 pound Steam Hammers, single and double frames.
- NEW No. 2 SIMMONS MICRO-SPEED Turret Lathe, 1¼", with cabinet base, speeds up to 1500 RPM. (Photo below.) See our display advertisement on Page 92.



SIMMONS
MACHINE TOOL CORP.

NORTH BROADWAY, ALBANY, N. Y.

NEW YORK OFFICE 149 BROADWAY

MOREY DEPENDABLE USED MACHINES

- Foster No. 1 Fastermatic Turret Lathe
- Gisholt 34" Turret Lathe, 7½" hole in spindle
- Oilgear #3 Horizontal Broaching Machine
- Natco 13H Hydraulic Multiple Drill
- Western 6' and 7' Plain Radial Drills
- Gleason 37" Bevel Gear Planer
- Brown & Sharpe #13 Spur & Bevel Gear Cutter
- G. & E. 24"x8" Spur and Bevel Gear Cutter
- Heald #25A Hydraulic Surface Grinder—With 24" chuck
- Landis 3½" Internal Hydraulic Race Grinder
- Becker #5B Vertical Miller
- Ingersoll 24"x24x12' Slab Miller
- Hendey No. 2G Univ. Miller —S.P.D.
- Hamilton 48" x 48" x 12' Planer—4 heads—M.D.
- Hamilton 42" x 42" x 20' Planer—4 heads
- Ohio 38" x 38" x 10' Planer —2 heads
- G. & E. 24", 32" Shapers—M.D.
- Landis 20 x 120" Plain Grinder
- Bliss #4 Toggle Press—Tie Rod
- Wagner Hydraulic Cold Saw—Cap. 7" Round
- Sellers 42" Car Wheel Lathes
- Hilles & Jones #3 Bending Roll.
- Nazel No. 2B Hammer
- Cleveland Plate Planer

THIS IS A PARTIAL LIST

• *Write us* •

your Specific Inquiries

MOREY MACHINERY CO., INC.
410 BROOME ST., NEW YORK

COME AND SEE DETROIT'S FINEST REBUILDING SHOP

6000 ft. Modern, single story Building devoted entirely to Rebuilding and Modernizing our own and Customer's Machines.

If you have machine tools you would like rebuilt, a phone call or wire will bring our representative to your plant to give an estimate.

SEE THESE MACHINES IN OUR WAREHOUSE

AUTOMATICS
#52 National Acme
#515 National Acme(2)
4⅜" Gridley, single spindle
Hayden ¾" 5-spindle
⅞" Model B Cleveland (2)

DRILLS
Allen 6-spindle 14" MD
24" Sibley & Ware
4-spindle Reed
4-spindle Woodward & Rogers
#33 Radial, bench model
10" Excelsior
20" Barnes
20" Superior
½" Commander, Electric
½" Utility, Electric
20" Silver
24" Aurora
14" Meyers
14" Barnes
Natco Minister, Multiple
24" Sibley, single spindle
3' Carlton Radial, sensitive (2)
3' American Radial, sensitive (2)
Weigle Vertical 1 spindle (3)
#2 Foote-Burt Rail 6-spindle
Bausch Multiple, 8-spindle

GRINDERS
#2 Cincinnati Plain
#70 Heald
#3 Modern Universal
Prosser Model AA
#1 Excelsior Double End

LATHES
68"x22' Fitchburg
Leblond Production
14"x6' American, motor in base
14"x5' LeBlond Production, heavy duty
20"x10' Lodge & Shipley
14"x7' Davis QCG MD
20"x8' Mueller MD
16"x6' QCG MD Monarch
14" Hamilton LCG
26"x10' Bridgeford
14"x6' Lodge & Shipley, QCG MD
17"x6' Sidney MD
12" Sheldon (new)
18"x8' Lodge & Shipley QCG MD
18"x8' Walcott QCG
5"5' Fitchburg LoSwing (4)
#6 LeBlond Multicut (4)
16"x6' Rockford Plain (2)
12"x4' American 47AP Bench type
16"x6' LeBlond

MILLING MACHINES
Oesterlein Plain (2)
#2 Kempsmith Universal
Ingersall Slab
#1 Kempsmith Universal
#4B Becker Vertical
Rockford Handmill, MD

SHAPERS
20" Davis MD
20" Gould & Eberhardt
20" Kelly MD
20" Stockbridge
8" Shape Rite (new)

PLANERS
Ohio 24x24x6
4" Wallace, bench

TURRET LATHES
#6 Brown & Sharpe
21" Gisholt
24" Gisholt
#4½ Bardons & Oliver

MISCELLANEOUS
Garvin Cam Cutters
24"x8" G & E Gear & Bevel Cutters
#3 LaPointe Broach
Combination Woodworking Machine
Vertical heads
Dividing heads
#101 Niagara Punch press
#PG5 Ferracute Press
Famco presses (new)
Rouselle's (new)
#63 Consolidated
Toledo Hack Saw
6x6 Racine hack saw
Klemm Metal Cutting Saw MD
Doty Bar Shear

BRADLEY MACHINERY COMPANY
Detroit, Michigan

Main office and Warehouse 211 Jos. Campau — Rebuilding Plant 1155 Bellevue

WHY RETIRE YOUR OLD TOOLS?

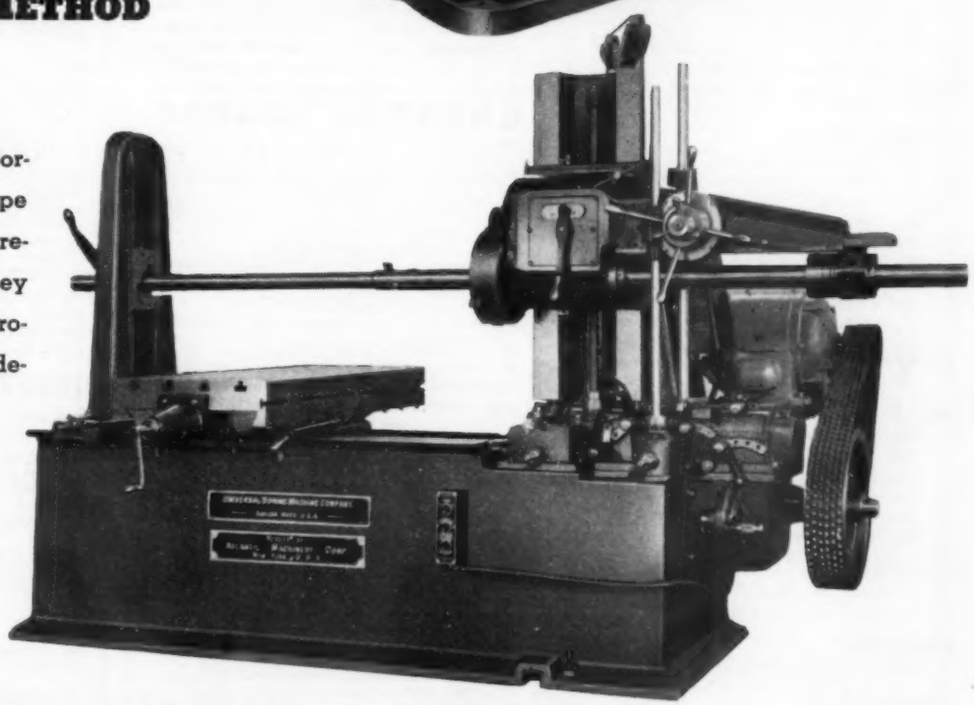
60 millers of this type have been rebuilt and all are hard at work here and abroad. All on defense work.

DON'T RETIRE YOUR OLD TOOLS

Modernize them with the new

"ATLANTIC" REBUILDING METHOD

8 similar Horizontal Boring machines of this type have been completely rebuilt and modernized. They are now working to full production capacity in the defense program.



After 30 Years of Service

COMPLETELY MODERNIZED TODAY!

Write for prices—tell us what tools need rebuilding—give complete details.

Atlantic Machinery Corporation, 149 Broadway, New York

...IN STOCK

AUTOMATICS
- 1¾" Gridley 4 spindle
- No. 6A Potter & Johnston

BROACHES
- No. 3 and No. 4 LaPointe

DRILLS
- 3 Ft Silver Radial, oil groove
- Rockford 4 spindle, No. 4 M.T.
- No. 12 Natco Multiple spindle
- No. 5 Fox Multiple spindle
- Natco 3 way Horizontal multiple spindle

GEAR CUTTERS
- No. 6 Fellows
- No. 12 Barber Colman
- 6" Gleason Straight Bevel
- 15" Gleason Spiral Bevel

GRINDERS—Cylindrical
- 18x96" Brown & Sharpe
- 16x50" Norton Crankshaft
- No. 20 Bryant Chucking

GRINDERS—Rotary
- No. 200 and No. 210 Heald—8" chuck

LATHES
- 15"x8' Carroll & Jamison, geared head
- 22"x14' Bradford, geared head
- 20"x12' Rahn Larmon
- 24"x10' Crawford
- 24"x14' Lodge & Shipley
- No. 6 LeBlond Multicut
- 11"x5' LeBlond Production-geared head
- 3½x60" Fitchburg Lo-swing
- 24"x12' Lodge & Shipley Duplex crankshaft

LATHES—Turret
- No. 4 Warner & Swasey
- No. 4 Warner & Swasey Universal
- No. 5 Foster
- No. 7 Foster
- No. 4 Millholland
- No. 4½ Bardons & Oliver
- No. 7 Bardons & Oliver
- No. 9 Bardons & Oliver
- No. 10 Bardons & Oliver

MILLS—Boring
- No. 3 Binsse Horizontal

MILLS—Plain
- No. 4 Cincinnati—S.P.D.
- No. 2 Cincinnati—S.P.D.
- No. 2B Brown & Sharpe S.P.D.
- No. 2 Rockford—C.D.
- No. 1B Brown & Sharpe—C.D.
- No. 33 Kempsmith—S.P.D.

PLANERS
- 24x24x8' American
- 36x36x14' Detrick & Harvey—Openside

PROFILERS
- No. 13 Pratt & Whitney

SHAPERS
- 16" to 24" Gould & Eberhardt
- 16" to 24" Smith & Mills
- 16" to 24" Steptoe

INDIANAPOLIS MACHINERY & SUPPLY CO., INC.
1960 South Meridian Street
INDIANAPOLIS, INDIANA

HILL-CLARKE
MOTOR DRIVEN GRINDERS

Sizes in stock:

6 x 32	10 x 72	16 x 72
10 x 18	14 x 36	16 x 120
10 x 24	14 x 50	18 x 96
10 x 36	14 x 72	18-30GAP x 96
10 x 50	16 x 50	21 x 96

HILL-CLARKE MACHINERY CO.
651 WASHINGTON BLVD. CHICAGO

MISCELLANEOUS MACHINES

1—½" **Landis** Double Bolt **Cutter**
2" **Landis** Double Bolt **Cutter**
3" **Landis** Single Bolt **Cutter**
Rockford Dbl. End **Boring Machine**
Rockford Sgl. End **Boring Machine**
4' **Hammond Sensl. Radial,** with tapp.
#13 **Natco Drill** with tapping att.
#14 **Natco Drill** with tapping att.
#30 **Natco Drill** with tapping att.
#40 **Natco** Strt. Line **Mult. Drill.**
48" **Newton** Cont. Dbl. Spdl. **Miller**
#400 **Curtis** 2-bushel **Oil Extractor**
#304-A **Oster Pipe Machine**
½" **Aetna Swaging Machine.**

THE STRONG, CARLISLE & HAMMOND CO.
1392 West 3d St., Cleveland, Ohio — 2832 E. Grand Blvd., Detroit, Mich.

1—#16A **Blanchard Surface Grinder,** Serial #1264.
1—11"x5' **Monarch Lathe,** A.M.D.
1—#12 **Natco Multiple Spindle Drill.**
1—#2 **Garvin Hand Screw Machine.**
1—#3½ **Pratt & Whitney Duplex Milling Machine.**
2—15" **Gleason Pinion Roughers.**
1—#17 **Barber Colman Gear Hobber.**
1—18"x6' **LeBlond Engine Lathe.**
1—30 Ton **Lucas Horizontal Press.**
1—24" **P. & J. Universal Shaper,** M.D.
1—18"x8' **Reed Engine Lathe.**

Your inquiries receive prompt attention

CENTRAL MACHINE TOOL CORPORATION
122-126 Nebraska Ave. Toledo, Ohio
Adams 1914

UNUSUAL VALUES

Brakes: Chicago 10' for 18 ga.
Shapers: 24" G&E, 16" Niles
28"x20'6" **Rahn-Carpenter Lathe** 14' between centers
24" x 16' **Greaves & Klusman.**
20"x10' **Bradford Lathe**
14"x8' **Young Lathe**
Turret Lathe 2¼" J & L
Turret Lathe: #4 Bardens & Oliver
Drill Presses: 28", 24" Hoefer; 25", 20", 40" Bement-
2 50# **Bradley upright hammers,** m.d. like new
Radial Drills: 5' Bausch
Miller: 20"x24"x18" Ingersoll
Grinders: #20 Bryant Internal; 6x15" Fitchburg, plain cylindrical
300 other machinery items
MOTORS—new 5 H.P. for 3-phase, ball brg. $55.75

Other sizes equally low priced. Also rebuilt motors.

THE OSBORNE & SEXTON MACHINERY CO.
COLUMBUS, OHIO

36"x36"x10' **Cincinnati Planer,** 4 heads. M. D. thru 4 speed gear box
4 & 6 Spindle Avery Sensitive Drills No. 2 M.T., B.B.
No. 1B, No. 2B Edlund, 2 Spindle Sensitive Drills
Landis Plain Grinders 12"x42", 12"x52", self contained countershaft, motor drive
Landis Crankshaft Grinders 16"x48", self contained countershaft, motor drive
20"x10' Monarch Lathe, Q.C.G. Cone
10' Robinson Toggle Type Press Brake
No. 12, 13 Natco Drills
Allis-Chalmers Rotary Compressor, 238 cu. ft. Direct M.D. as good as new

IROQUOIS MACHINERY CO.
662 Ohio St. Buffalo, N. Y.

OTT MACHINERY SPECIALS

AUTOMATICS, B.&S. #00, 2 & 2G
AUTOMATICS, Cleveland ⅝ to 2¼" Model A
AUTOMATICS, Gridley, ⅞, 1¼ & 1¾" Model F
BORING MILLS, King 42" 2 Swivel Hds.
BORING MILLS, Niles, 54" 2 Swivel Hds.
GEAR SHAPER, Fellows, #61
GRINDERS, B.&S. #14—10x36" Plain
GRINDERS, Landis, 10x24" Self Cont'd
GRINDERS, Landis, 16x72" Plain
GRINDERS, Norton, 10x18, 24"
MILLING MACHINES, Rockford #2B Universal
MILLING MACHINES, B.&S. #12 Mfg'g.
PLANERS, Gray, 30x30x18' 2 Rail Hds.
PRESSES, Toledo, #661—150 ton Coining
PROFILERS, Pratt & Whitney #13

OTT MACHINERY SALES, INC.
542 Second Ave. Detroit, Mich.

EXCEPTIONAL TOOLS

SHAPERS
24" Cincinnati B.G. cone drive.

LATHES
54"x16" Johnson, motor drive.
42"-60"x24' New Haven, belt dr.
20"x12' LeBlond, belt dr. D.B.G. quick change.
40 Lathes in stock, all sizes.

CONTINUOUS MILLER
8D Becker Vert. continuous m.d. table 40" dia.

GRINDERS
12"x36" Pratt & Whitney Surface belt drive.
12"x36" Modern, plain cylindrical.

TURRET LATHES
#1 W & S ⅝" capacity, belt drive.
6A Potter-Johnson, geared head.

BORING MILL
42" Bullard, 2 heads, mtr. dr., q.c.

THE O'BRIEN MACHINERY CO.
113 N. THIRD ST., PHILA., PA.

Holden-Morgan Thread Millers
P & W Trundle Type Thread Millers
Coulter 2-spindle Diamond Boring Machines
No. 1 Adams Gear Hobber

D. E. DONY MACHINERY CO.
47 LAURELTON ROAD
ROCHESTER, N. Y.

POWER PRESSES
BLISS, TOLEDO, V & O, ETC.
REBUILT — GUARANTEED
JOSEPH HYMAN & SONS
Tioga, Livingston and Almond Streets
Philadelphia, Pa.

IN STOCK AT FALK'S

PIPE MACHINES

2" Jarecki 4" Curtis
2½" Landis 6" Jarecki
12" Saunders

BROACHING MACHINES

#4 LaPointe of Hudson
#3 LaPointe of Hudson

PAPER CUTTERS

42" ACME, Power Clamp
24", 30",54" Jacques Hand

GEAR CUTTING MACHINERY

Adams #1 Hobber; 12" (2)
Whiton Spur Gear Cutter #2
Whiton Automatic Univ. Cutter #2
Schuchart & Schutte 18" Hobber
Barber-Colman #12; M.D. (3)
Barber-Colman #3 with Power Feed M.D.
Barber-Colman #3 standard; belt dr.
G&E 48" Cutter; fine condition

RIVETERS & HAMMERS

#2 Marquette Riveting Press; back geared; M.D.; Air Cushion
#80 Grant Rivet Spinner
#0 Grant Bench Type Rivet Spinner
#1A Rochester High Speed Hammer
#1B Rochester High Speed Hammer
#2A, #3A, #3AHD, #4AHD, #5½B, #6B Rochester High Speed Hammers
#1 Campbell Nibbler 3/16"; 6" throat
15# Bradley Upright
50# Little Giant Upright
400# Miner & Peck Drop Hammer with Auto Lifter
200# Bliss Board Drop, poppet base (new)
#5½B ROCHESTER HIGH SPEED RIVETING MACHINE, M.D.

AIR COMPRESSORS

6x6 Bury, horizontal
6x6 Curtis Vert., twin
7½x6 Ingersoll-Rand, type REI
9x8 Blaisdell-Bradford
10x10 Chicago, Pneumatic and motor, etc.
12x10 Ingersoll-Rand
10x8x7½ American "Fairhurst" High Pressure
14x14x8 American "Fairhurst" 500 CFM

ENGRAVER

#3 Zeiss, Flat & Tubular Work; belt drive

SAWS

Cochrane-Bly #1B; 2B; 4B Cold Saws
Laidlaw Metal Cutting Band Saw; M.D.
Racine 10x10, belt drive, 6x6; (3)
Peerless 6x6, belt dr.; cab base
Toledo 6x6 M.D. new High Speed Hack Saw
Wallace direct connected M.D. 18" Band Saw
#11 C&B Saw Grinders (3)
30", 36" American & Sidney Band Saws
#4 American Band Resaw

SPOT WELDERS

WELDER, Federal 30 KVA, #412B, 220 Volts; Various Sizes.

PRESSES

#5 American, S.S. Geared
#37½ Bliss, S.S. Geared
#37½ Bliss Plain Flywheel
#14 Toledo Horn
#25 Niagara Arch
#30 Bliss Arch
#21½ Bliss OBI, Grd (3)
#21½ Bliss OBI Plain; M.D.
#21 Bliss OBI, Plain
#20B Bliss OBI, Plain
#20 Bliss OBI, Plain (1)
#19C Bliss OBI, Plain (2)
#19 Bliss OBI, Plain (2)
#18 Bliss OBI, Plain (2)
#2½ V&O Plain Press; OBI
#3 American Can Co., Plain, OBI
#36 Niagara Back Flywheel
#46 Perkins Grd, back flywheel
#16 Bliss Horn, M.D.
#14 Stoll, OBI
#3R Marquette, Grd M.D.
#1 Bliss Toggle
6-ton General Flexible
12-ton General Flexible
#5 Greenard Broaching
#4 Adriance, OBI, Plain
#75 Toledo OB, Geared
#6 Waterbury-Farrel, OBI, Plain
#61 Reducing Press, Bliss
25-ton Henry & Wright

FLATTENING ROLLS

12x22" Farrel
6x12" Farrel, wobbler type

SHAPERS & KEYSEATERS

14" Whipp
15" Potter & Johnson, Univ
15" Steptoe back geared
16" G&E, cone drive
16" Hendey friction drive
16" Stockbridge
16" G&E High-Duty
20" Kelly
20" Cincinnati
24" Kelly
20" Mattison
24" Cincinnati
26" Smith & Mills
24" G&E, S.P.D.
24" G&E cone
28" G&E, "Invincible"
#3 Baker Keyseater, 7"2 cap.
#0 Mitts & Merrill Keyseater 1"
12" Bement Slotter

40" BAUSCH VERTICAL BORING MILL

Motor Driven, 27 speeds; 15 feeds; chuck jaws; 2 heads power elevation. Inspection under power.

AUTOMATICS

#52 ACME
#53 ACME
1¾" GRIDLEY Model "F"
12x6 J&L Hartness Chucker
CLEVELAND 2½" Bar Horizontal Boring Mill
CLEVELAND 4¼" Model A Automatic Screw Machine

BRAKES

8'x3/16" OHL Press Brake large variety Dies; M.D.
3' Hand Box & Pan Brake; 14 ga. D&K
3' Hand Bending Brake; 14 ga. D&K

BORING MILLS

52" NILES TOOL WORKS
24" BULLARD Vertical "New Era"

THREAD MILLER

SMALLEY GENERAL 6" hole in spindle, Belt Drive
2—4½x12 P&W

SHEARS

#196 NIAGARA 8'x16 ga. Ft Pr Equal to new
#748 NIAGARA Grd. M.D. (3) 48"x3/16" cap.
#236 NIAGARA Grd. Underdriven; M.D. 36"x14"
10'x⅜" WAISS & ROOS M.D. 24" gap

#4 MILHOLLAND - LASSITER STAYBOLT MACHINE, M.D.

IRONWORKERS

#1 BUFFALO, Univ. 3x3x⅜" angles
#0 BUFFALO Bar Shear, 2x2x¼" angles
#1 PELS Hand Univ. Ironworker

DRILLS—Heavy Duty Upright

BAKER #216; #121
COLBURN #2
FOOTE BURT #25 like new
SNYDER 36"; #5 Taper; 28"; 24"
BARNES 24" Sliding Head; 21"; 20"
CINCINNATI-BICKFORD 28" Tapping Attach.
CINCINNATI 24"; 21"
AURORA 24" with Tapping Spindle

GRINDERS

10x36" M.D.
14x50 Norton Plain Grinder
#2 Landis Univ. Cyl. Grinder
#10 Plain Brown & Sharpe, 6x18"
Worcester Internal Grinders; belt dr. comparable to #70 Heald (2)
#6 Rivett Internal Grinder; belt dr.
#22 B&S Internal Grinder

SCREW MACHINES

1—#4 Warner & Swasey, Universal Turret Lathe
1—#2 Warner & Swasey, Turret Lathe
1—#3 Bardon & Oliver, Turret Lathe, Geared Head
2—#2 Foster, Turret Lathe
1—#1 Foster, Turret Lathe
1—#6A Potter & Johnson, Autom. Turret Lathe
1—#4 Acme 1½" Hand Screw Machine

DRILLS—Sensitive, High Speed

#3 AVEY Single & Multiple Spindle
AVEY #2, Single & Multiple Spindle
LELAND GIFFORD Single, two & four spdles
HENRY & WRIGHT Single, and two spindle #2
KOKOMO #3 and #2 Single Spindle
FOSDICK #2 Super Speed with Tapping Att.
MOLINE #5 Hole Hog, 6 spindle Rail
HARRINGTON #2, 12 spindle Multiple Like New.
FOX Multiple Spindle; #2 M.T.; 8 spindles
NATCO #11; 12 spindles; #1 M.T.
100 spindles additional Drills all sizes

RADIAL DRILLS

6' NBP 15" column
5' AMERICAN 13" column
4' CINCINNATI BICKFORD 11" col.
4' BICKFORD 11" column
4' NBP 11" column; Semi-Univ.
3½' SILVER 9" column
3' AMERICAN 9" column
3' MUELLER 9" column
3' DRESES 9" column
3' DRESES (SIMPLEX)
3' CARLTON Sensitive, M.D.
4' DRESES Flat Column

LATHES

4"x104" LeSwing Fitchburg (2)
4"x60" LeSwing Fitchburg (3)
4"x48" LeSwing Fitchburg (2)
9"x42" South Bend Bench Lathe
8"x36" American Bench Lathe
12"x5' Willard, Geared Head
13"x6' P&W Gage-Makers Lathe
13"x6' Willard, cone drive
14"x6' Standard Lathe Works, cone
14"x6' Rockford, Q.C.G., cone drive
14"x8' LeBlond Tool Room Lathe, cone
14"x6' Hendey, Geared Head
14"x6' LeBlond, Q.C.G., cone drive
14"x6' L&S, quick change gear, cone
16"x6' L&S, 12 speed geared head
16"x6' MONARCH QCG cone drive
16"x6' P&W, plain change; cone drive
16"x6' REED Plain Change; cone drive
16"x8' Cincinnati, QCG, cone dr. Taper
16"x8' Cincinnati, QCG, cone dr.
16"x10' Reed-Prentice, QCG, cone drive
17"x8' Sidney, Heavy Duty, QCG; cone
18"x8' Chard, semi-quick change gear; cone
18"x8' Mueller, QCG, cone drive
18"x8' Mueller Pl. Turning, Heavy Duty
18"x8' Clsce, QCG, cone drive
18"x8' Hamilton QCG, cone drive; taper
18"x12' Prentice, Pl. Change; Taper
18"x12' Hamilton, Pl. Change; Chuck, cone
19"x8' LeBlond Heavy Duty Production Lathe
20"x10' Davis, Plain Change; cone drive
21"x8' LeBlond Heavy Duty With Turret
24"x12' Crawford-Erie, Q.C.G., cone (2)
24"x16' L&S, Taper; Q.C.G.; M.D.
26"x9' Bridgeford Q.C.G. cone drive
26"x16' Greaves-Klusman, Pl. Change
42"x20' Gleason Plain Change; cone. Internal geared face plate; 11'6" centers

3—MADISON-KIPP Die Casting Machines.

ROLLS

84"x8" Pinch Type
84"x4" Rolls; slip type
48"x3½" Rolls; slip type
36"x3" Rolls; slip type
7' Pinch Type BENDING ROLL, 8" Rolls

MILLERS

#9 Van Norman (2)
#1½ Van Norman (4)
#1 Van Norman
#1½ Rockford, Plain
#1½ B&S, Plain
#6 Whitney, Hand
#4 Burke, Bench P. Feed
#3 Burke, Bench
#5 Stark, Precision, Univ
#2 P&W Spline Miller
#6 Jackson Die Sinker or Vertical Miller; Q.C.G.
&4 Burke, Bench, Pr Feed
Box, arr. M.D.
KEMPSMITH #1 UNIVERSAL MILLER
CINCINNATI #2 UNIVERSAL MILLER
#3 Ohio Plain Milling Mach.

FALK MACHINERY CO., INC.
Machinery Merchants
18 WARD STREET ROCHESTER, N.Y.

Partial Listing Only. Send Us Your Inquiries!

HIGH GRADE MACHINE TOOLS

LATHES

15"x 8' Cisco Q.C. Cone drive.
24"x12' Bradford Engine Lathe, 3 S.C.D. Q.C.
20"x12' Hamilton, Q.C. Lathe, 3 S.C.D.
14"x 6' Vernon Q.C. Cone drive.
18"x 8' Monarch Screw Cutting Cone drive, Q.C.
36"x16' Boye & Emmes, Trip. Grd. Cone drive, Q.C.
50"x14' Pittsburgh, Trip. Grd. H.D. Q.C.
16"x 8' American Grd. Hd. S.P.D. T.A.

GRINDERS

5"x18" Ott Plain Grinder, Belt drive.
8"x22" Willmarth & Morman Surface, Belt drive.
#29-53" Besley B.B. Vertical Spindle Disc Grinder.
30" Gardner Motor driven, power oscillating Table Disc Grinder.
#55 Heald Internal Grinder, Belt driven.

GEAR CUTTERS

#3-26" B & S Gear Cutter.
#1 and 3 Adams Gear Hobbers.

BORING MILLS

3" Rochester Horz. S.P.D.
3½" Bar Niles Horz. Boring Mill.
84" Pond Vertical Heavy Boring Mill, 2 Hds.

BOLT & PIPE THREADERS

2" Landis with Lead Screw Cone drive.
3" Landis Cone drive.
1" Acme Cone drive.
2" Landis Pipe Machine Cone drive.
2" Acme Cone drive.

RADIAL & UPRIGHT DRILLS

6' Fosdick, Flat Column Radial Drill S.P.D.
3' American Trip. Grd. Radial.
20" Barnes 4 spindle drill.

SHAPERS & PLANERS

20" Cincinnati Cone Drive Back Geared.
24" Queen City H.D. Cone Drive Back Geared.
24" Hollingsworth Cone Drive, Back Geared.
30"x30"x10' Cincinnati Planer, Motorized.
30"x30"x8' Gray Planer, Belt Drive.
32"x32"x8' Woodward & Powell 2 Hds.

MISCELLANEOUS

6'x3/16" D & K Brake Motor driven. Leaf type.
¾" Five spindle Hayden Automatics.

CINCINNATI MACHINERY & SUPPLY CO.
217 East Second St. Cincinnati, Ohio

HIGH GRADE TOOLS

18" Gisholt Simplimatic.
4¼" Gridley single spindle.
No. 3 Oilgear broach.
No. 45 Heald 8 spindle borematic.
20" Barnes AGSO drill tap, attmt.
21" Cincinnati Mfg. type drill.
60 spdl. No. 32 Natco multi drill.
5' American universal radial drill.
No. 12 H8 Gould & Eberhardt Mfg. hobber.
3000 amp. Jantz & Leist plating M.G. set.
17"x36"—48" Norton hyd. crank pin grinder.
8" No. 200 Heald rotary surface grinder.
No. 78 Wilmarth & Morman surface grinder.
No. 1 Sellers lathe & planer tool grinder.
Pratt & Whitney worm grinder.
No. 78 Heald internal grinder.
36"x22' Schumacher & Boye triple gear lathe.
22"x12' Morris geared head lathe.
24" Bullard with side head.
4" Landis floor type boring mill.
42" Bullard vertical boring mill.
52" Gisholt vertical boring mill.
60" Colburn vertical boring mill.
No. 1 Cincinnati plain miller.
No. 2½ Rockford plain miller.
No. 3 Brown & Sharpe plain miller.
No. 2B Rockford universal miller.
No. 4 Cincinnati universal miller.
Model AB Becker vertical miller.

Ask for list No. 172

MILES MACHINERY COMPANY
SAGINAW, MICH.

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SLAB MILLER

Newton, adjustable rail, 35" between housings, 31" between gibs; table 30"x 11'4" overall; has horizontal arbor and vertical head; pump, piping, arranged for motor drive; weight about 32,000 lbs.

LATHE

27"x15' Reed-Prentice, taper attachment, standard change, arranged for variable speed motor drive.

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1000 MACHINES FOR SALE

Lathes, Milling Machines, Shapers
Boring Mills, Slab Millers, Drills
Punch Presses, Squaring Shears
Wire Forming & Cutting Machines
Bolt, Nut and Rivet Machinery
At Reasonable Prices

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for

TURRET LATHE AND AUTOMATIC SCREW MACHINES

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WE HAVE NO LISTS—This Is Moving Too Fast for Any Kind of Permanent Listing. Best Bet Is to Send Your Shop Man to Select While the Stock Lasts.

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30 Milling Machines

Shapers — Lathes
Drill Presses — Planers
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Arbor Presses—all sizes
Universal & Cutter Grinders

All our own rebuilding—fully guaranteed

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Established 52 years—same family

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ORGANIZED TO HANDLE EXPORT ORDERS

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MILLING & SHAVING MACHINE

NEW, AND STILL IN ORIGINAL CRATES—Newton L-94 Special Milling and Shaving Machine complete with: 1 vertical spindle, 5 H.P.; 3 horizontal spindles, on side, 15 H.P. total; 1 horizontal spindle, opposite side, 10 H.P.; table drive—hydraulic center feed, through a 20 H.P. motor. Maximum width between horizontal cutters—21". Milling face of vertical spindle—10" from center line of horizontal spindles. All spindles adjustable. Crocker-Wheeler motors—constant speed, 440-V, 3-phase, 60 cycle. Address

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60" x 20' Putnam Triple Geared Internal Face Plate Drive; B. D.
36"-60" Harrington Sliding Bed Gap; bed closed 16'—open 23'; B. D.
24" x 12' Hamilton; B. D.
18" x 8' Reed; M. D.

GRINDERS

#2 Landis Universal; #2 B. & S. Univ.;
#24 Gardner Disc; 53" dia.

SUN MACHINERY COMPANY, Inc.
36 Van Vechten St. Newark, N. J.

16"x12' Rahn-Larmon Lathe, Grd. Hd. T.A.
18"x12' Hendey Lathe, Grd. Hd., T.A.
24"x10' Lodge & Shipley Lathe, B.D.
26"x18' Pittsburgh Lathe, B.D. T.A.
42"x16' Schumacher-Boye Lathe, B.D.
21" Gisholt Tur. Lathe, 3½" hole, B.D.
15" Potter & Johnson Univ. Shaper, M.D.
16" Cincinnati Shaper, B.D.
#14 Cochrane-Bly Vert. Miller & Shaper, M.D.
#13½ Garvin Plain Miller, B.D.

WEST PENN MACHINERY COMPANY
1210 House Bldg. Pittsburgh, Pa.

Notice to Advertisers

Because of the Holiday, Independence Day, July 4th, the "Searchlight" pages of the

JULY 9th ISSUE OF

AMERICAN MACHINIST

close for press earlier than the usual closing time.

The cooperation of advertisers is solicited in forwarding new copy, or changes of copy, to reach us accordingly.

FINAL CLOSING TIME
MONDAY, JUNE 30th

Two Ifs...

If you have in your plant any

Lathes
Milling Machines
Boring Mills
Shapers
Planers
Presses
Drills
Grinders
Turret Lathes
Screw Machines
Gear Machines
Sheet Metal Machines

which you can possibly spare for work of the most urgent National importance — please offer it to us. We have many inquiries from firms who badly need machinery for work of the highest priority.

If on the other hand, you are in need of any of the above types of machines, please get in touch with us. We will do everything possible to help you.

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No. 1 Barrett
No. 2—5" Bar Barrett, Extension Bed

BORING MILLS
30" Bullard
42" Bullard, 2 hds.
72" Bickford

DRILLS
1, 2, 4 spdl. Henry & Wright
No. 2—4 spdl. Leland-Gifford, Motor Spindles with Power Feed
1, 2, 4 spdl. Leland-Gifford
No. 23—24" Foote-Burt
No. 2 Colburn, 4 spdl.
No. 314 Baker
No. 4—5 Spdl. Foote-Burt Rail
10 spdl. Boley Multiple
No. 1 Baush Multiple
No. 3 Baush Multiple

RADIALS
3½' Cincinnati-Bickford Radial
6' Niles-Bement-Pond Univ.
7' American Full Universal
8' Western Heavy

GEAR CUTTERS
No. 2 Barber-Colman
No. 12 Barber-Colman
No. ½ Pfauter Hobber, M.D.
No.2—36" Pfauter Hobber
No. 3—26" Brown & Sharpe
No. 4—48" Brown & Sharpe
No. 5—48" Brown & Sharpe
No. 6—72" Brown & Sharpe
No. 6-A 72" Cincinnati
Nos. 0, 61, 62 Fellows
96" Newton Spur Gear Cutter
No. 36BM G&E Bevel Rougher

GRINDERS
8" Arter Rotary Surface
16"x32" Landis Crankshaft
No. 2½ Universal (Bath Type)
10"x36" Thompson Universal
No. 4—12"x60" Landis Universal
No. 70 Heald Internal
No. 5 Springfield Planer Type Surface
No. 2—18" Gardner Disc

LATHES
3½"x36" Fitchburg Le-Swing
3½"x60" Fitchburg Le-Swing
3½"x108" Fitchburg Le-Swing
8"x60" Fitchburg Le-Swing
18"x6' Bradford Geared Head
18"x8' Lodge & Shipley
20"—40"x10' Rahn-Larmon Geared Head Sliding Bed Gap
21"x10' LeBlond
24"x12' American
24"x13' Chard
24"x16' Lodge & Shipley
24"x18' Lodge & Shipley
24"x20' L. & S. Grd. Hd., Taper
24"x22' Lodge & Shipley, taper attachment
25"x10' LeBlond
27"x18' American Geared Head, taper Att.
30"x12' Whitcomb-Blaisdell
30"x12' Lodge & Shipley
36"x24' Bradford Triple Geared, Taper Att.
40"x12' Fifield Triple Geared

MILLERS
No. 3 Becker-Brainard Pl.
Type "B" Briggs Mfg.
No. 4-B Becker Vert.
No. 5 Brown & Sharpe Vertical
No. 5-B Becker Vertical
No. 6 Becker Vertical
8" P&W Automatic
Model ACS Becker Vertical
Model C2 Becker Vertical
24"x24"x12' Ingersoll Adj. Rail
24"x20' Ingersoll Dbl. Faced
36"x36"x12' Newton Duplex
38"x44"x20' Ingersoll Slab
72"x16"x14' Ingersoll
No. 1 Smalley-General Thread

PLANERS & SHAPERS
24" Flather, S.P.D.
26" Springfield
24"x24"x6' Cincinnati 2 Heads
24"x24"x6' Powell
24"x24"x6' Rockford
24"x24"x12' Gray
30"x30"x8' American
30"x30"x8' Powell
36"x36"x12' American
36"x36"x8', 18' Cincinnati
42"x42"x12' Liberty
42"x42"x14' Gray
48"x48"x10' Niles-Bement-Pond
48"x48"x12' Gray, Reversing M.D.
60"x48"x24' Hamilton
72"x60"x16' American

PRESSES
No. 01 V&O O.B.I.
No. 1 V&O O.B.I.
No. 393 Bliss Straight Sided
No. 178 Toledo Toggle Drawing
No. 58 Toledo Nosing

TURRET LATHES
16" Acme Brass Lathe
2¼"x26" Greenlee, A.C. & B.F.
3½"x40" Greenlee
24" Steinle, 6½" H.S.
21" Gisholt, 3½" H.S.
24" Gisholt, 6¼" H.S.
18" Libby
26" Libby, 7½" H.S., Taper Att.

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2" Cleveland Model A
⅝ Cleveland Model A
⅝-⅞ Cleveland Model A
2—1" Cleveland Model A

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3½" Bar D & H Floor type Universal circular tilting table
1—No. 12 P & H Floor type A.C. Motor Drive

BORING MILLS—VERTICAL
10—16' Betts (new condition)
60" Niles
42" Niles, Bement & Pond, Motor Drive
42" Bullard Mtr. Dr. 1 Pl. head
1 turret head rapid traverse
42" Colburn, Motor Drive
48" Niles, Bement & Pond Car wheel Borer Mtr. Dr.

DRILLS
4' Bickford Universal
2 and 4 spindle Henry & Wright sensitive
4 Spindle Fox
4 Spindle Demco Power Feed to Spindle
4—22" Barnes Power Feed Motor Dr.
1—36" Cincinnati Bickford
1—36" Aurora
1—36" Superior
1—4 Spindle Barnes—82" table Power Feed to Spindles
2 Spindle Rockford Mtr. Dr. tapping attachment
2 Spindle Webster and Perks Horizontal tapper

GRINDERS
10x48 No. 14 B & S
8x36 Fitchburg plain
10x24 Landis plain
2½ Bath Universal
2—3 B & S Tool and Cutter
12x36 Landis Universal
8x36 Morse plain
Hardinge Precision
#11 B & S plain
3—#2 Wilmarth & Morman Tool and Cutter
1—#1 Norton Tool and Cutter
1—12x36 Modern plain Self-contained Mtr. Dr.
1—Walker Rotary Surface 14" Dia. Magnetic Chuck
2—#2 Reid Surface Grinder with Magnetic Chuck

GRINDERS (Con.)
2—#2 Oakley Universal Tool and Cutter Grinders
#75 Heald Internal Grinders
1 Bristol Rotary with Magnetic Chuck

LATHES
3—12x5' Cleveland Geared head Taper Attach.
14x 8' American C.P.D.
16x 8' Flather Mtr. drive
17x 8' South Bend
18x10' South Bend
14x 8' LeBlond Geared Head
18x8' Mueller
2—18x8' Morris taper attach.
24x12' Shoemaker and Boye
30x18' Monarch Taper Attach.
32x20' New Haven
48x18' American Triple gear
56x24' Fifield Triple Geared
4x60" Fitchburg Low Swing (New Condition)
16"x8' Carroll Jamison, 3-step cone, double back gear
16"x10' Sebastian geared head, 8 speed head
30"x15' Rahn Mayer Carpenter

PLANERS
48x48x14' Patch, box table, reversing Mtr. drive, 2 rail heads, 2 side heads
56x56x11' Gray, reversing Mtr. drive—2 rail heads—2 side heads
30x30x8' New Haven

TURRET LATHES
No. 0 Bardens and Oliver
18x8 LeBlond, full universal
3¼ Greenlee with cross slide
6¼" Steinle geared head
No. 4 Warner & Swasey
3 No. 2 Warner and Swasey
No. 1 Bardens & Oliver
2¼"x24" J & L Bar equipment
1 with power feed to turret

MILLERS
1 No. 2 LeBlond plain
No. 4H LeBlond Universal
No. 2 Kempsmith Universal
Hendey & Becker Lincoln type
1A Becker Vertical rotary table (new condition)
2—No. 1 Fox Plain Foster Thread Miller
#3 Lees Bradner Thread Miller
No. 3 Hendey oscillating

MILLERS (Con.)
2—Van Norman Hand Millers
2—#1½" Bilton Plain Millers
#5 Becker Vertical

PRESSES
Bliss Inclined geared Mtr. Dr.
4—18 Bliss O.B.I.
3—19½ Bliss O.B.I.
4¾ Michigan O.B.I.
Ferracute Bench O.B.I.
92C Toledo geared motor drive, steel tie rod
61 Toledo Arch geared motor drive
No. 37 Niagara, back flywheel motor drive
No. 6 Stiles and Parker geared

SHAPERS
26" Kelly Motor Drive
24" Milwaukee C.P.D.

WELDERS
1—50 K.W. Thompson Spot Automatic
1—35 K.W. Thompson Spot Automatic
2—200 Amp. Lincoln Arc Portable

PIPE MACHINES
10" Cox
203A Oster 6" capacity
10" Bignall & Keeler
2" Bignall & Keeler Motor Drive
Acme & Landers Bolt Threading Machines

SAWS
6x6 Racine Hack Saw Motor Drive
#3 Burr Cold
#12 Higley Cold
12" Stirling Hack Saw
#3 Klemm Metal Band Saw

MISCELLANEOUS
#1 Buffalo Iron Worker Motor Drive
12x10; 9x8; 5x4 Ingersoll Rand ER-1 Compressors
6'x10 ga. D. & K. Leaf Type Brake
3 Grant Rivet Spinners
3A High-Speed Hammer
Morton Key Seater 4" capacity
No. 0-2-3 Lapointe Broaches
2 Producto-Matics
1 No. 1 Gray Nibbler, Turret Type
10 Double Leg Stream Forging Hammers, capacities 1,000 to 4,000 lbs.

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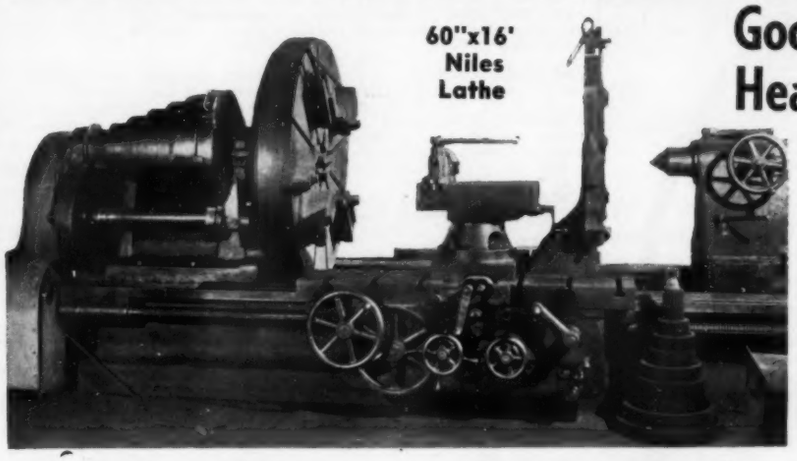
2 Good Pond Planers—2 Niles Lathes

Good for a Lot of Heavy, Hurry-Up Work!



60"x16' Niles Lathe

36' x 36' x 8' POND PLANER

2 heads on cross-rail . . . square base . . . tight and loose pulleys for countershaft drive.

72' x 72' x 12' POND PLANER

2 heads on cross-rail . . . 2 side heads . . . tight and loose pulleys for countershaft drive.

PROMPT DELIVERY FROM MILWAUKEE PLANT

Advance Manufacturing Company

900 E. Keefe Avenue — Milwaukee, Wisconsin

The 60" x 16' Niles Engine Lathe

Triple gear . . . tight and loose pulleys for countershaft drive . . . plain change gear with gears . . . compound rest . . . 54" face plate with adjustable chuck jaws. 30" face plate . . . large and small steady rest . . . extra 6" raising block.

The 24" x 20' Niles Engine Lathe

Plain change gear, with gears . . . 5 step cone . . . single back gear . . . tight and loose pulleys for countershaft drive . . . compound rest taper attachment . . . 2 steady rests . . . Large and small face plates . . . 24" four jaw independent chuck.

Subject to Prior Sale

BOTH AT SPECIAL PRICES

42" Bullard-Rapid Traverse

54" New Haven S. Q. C. Engine Lathe

#173-B Consolidated Press, O. B., open belt drive

J. LEE HACKETT COMPANY

5838 Commonwealth Avenue

Detroit, Michigan

6-1 Cleveland O.B.I. Press M.D.

42" King Boring Mill, 2 swivel heads

16 x 72 Landis Grinder

14 x 6 Hamilton Lathe

Two (2) 10 ton Hydraulic Presses, self contained

12" Pratt & Whitney Surface Grinder

2—#00 B & S Screw machines

#19 B & S Screw machine

#1½ Grand Rapids plain Mill

Mills-Gavan Machinery Sales

6535 Russell — Detroit, Mich.

Tr 2-3615

TURRET LATHES

10" 2-spdle Jones & Lamson, Steel Head.
3"x36" Jones & Lamson.
No. 1B Faster Universal.

SHAPERS—PLANERS

24" Potter & Johnston Shaper.
36" Morton Draw Cut Shaper.

BORING MILLS

2—72" Bickford Verticals.
1—4" bar, Beaman & Smith Floor Type Horiz.

MISCELLANEOUS

500# Bradley Hammer. No. 14 Colburn Drill.
8" Weiland Pipe Machine, M. D.
#4 Hilles & Jones Double Punch Shear.
#4—48" Brown & Sharpe Gear Cutter.
2" Pratt & Whitney Spline Miller.
22"-46"x12' Putnam Cap Lathe.
9" x 9" Peerless Shaping Saw.
No. 178 Toledo Toggle Drawing Press.
No. B-16 Natco Multiple, 34 spindles.
No. 215A Cochrane Bly Hi Speed Saw.

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One 3 ft. x 3 ft. x 10 ft. **Gray planer,** completely motorized with all electrical controls; first class condition.

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SOUTHWARK. Type 3SE Vertical, Wt. 11000#, Shop #31453, G.E. 3/60/440. Equipped with punch and shear blocks.

ON INTERMITTENT PRODUCTION ONLY ONE YEAR.

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BORING MILL, Vert. 72" Colburn, R.P.T., M.D.
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GEAR CUTTER, Spur, 84" Newark, M.D.
GEAR PLANERS, Bevel, 54" Gleason, M.D. (3)
GRINDER, Univ. No. 5 B & S, 20"x72", B.D.
LATHE, 27"x18' Sidney, Q.C.G., D.B.G., T.A.
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REEVES Glengarrie POPLIN

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Men who handle machinery demand work uniforms that withstand heavy strain. So specify *Reeves* famous fabrics when ordering *your* uniforms!

Uniforms made of Reeves Army Twill meet exacting U.S. Government Tests for better wear, longer life, and color fastness. Its fabric vitality keeps "in shape."

GLENGARRIE POPLIN for matching shirts. A durable, stylish fabric that comes in a wide range of colors. Both fabrics are Sanforized* against shrinking.

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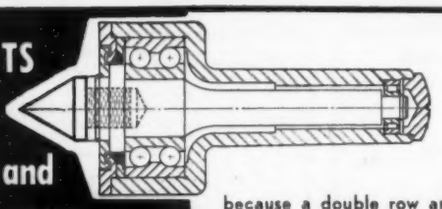
See your nearest dealer for uniforms, sport and work clothes made from these famous fabrics, or write for leaflet to:

OVER 35,000,000 yards of Reeves Army Twill sold to the U. S. ARMY

REEVES BROTHERS, INC.
54 WORTH STREET NEW YORK

POINTS RUN TRUE and STAY TRUE At All Speeds



because a double row angular contact preloaded ball bearing and the ground-after-assembly point contribute to the accuracy and rigidity of Red E Live Centers at all speeds.

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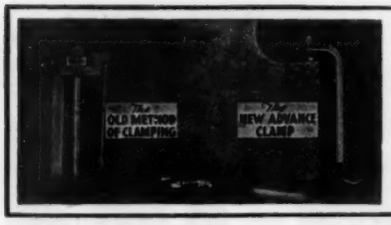
IRANISTAN & R.R. AVES. BRIDGEPORT, CONN.



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Through use of the new Advance Clamp
For use on all machines with T-slots
Standard and heavy duty types
ADVANCE MACHINE WORKS
37x7 Weisser Park
Fort Wayne, Indiana

LUCAS "PRECISION"
Horizontal Boring, Drilling and Milling Machine
THE LUCAS MACHINE TOOL CO.
NOW AND ALWAYS OF
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ALLOYS, Steel
Allegheny Ludlum Steel Co., Breckenridge, Pa.

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Landis Mach. Co., Waynesboro, Pa.
Haskins Co., R. G. Chicago, Ill.

BOLTS, Eye, T Slot
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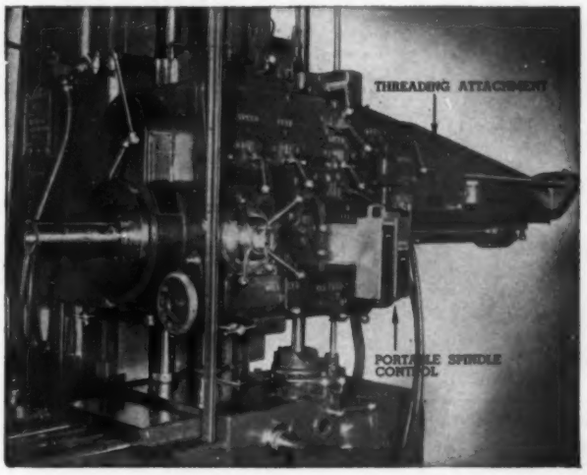

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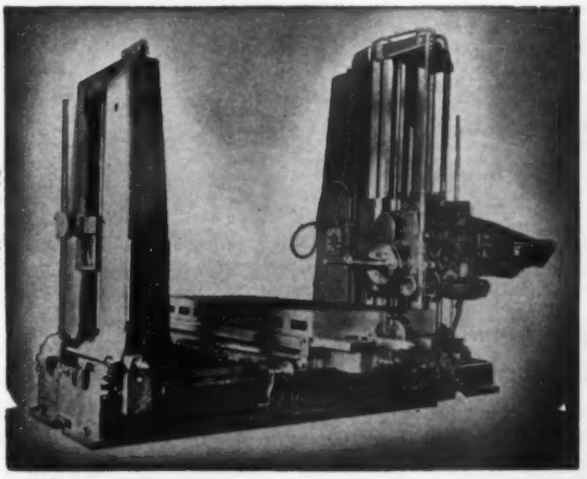

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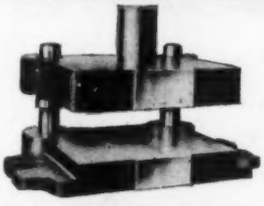

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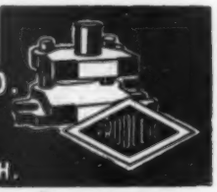

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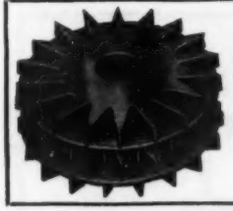

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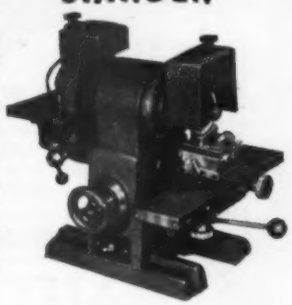

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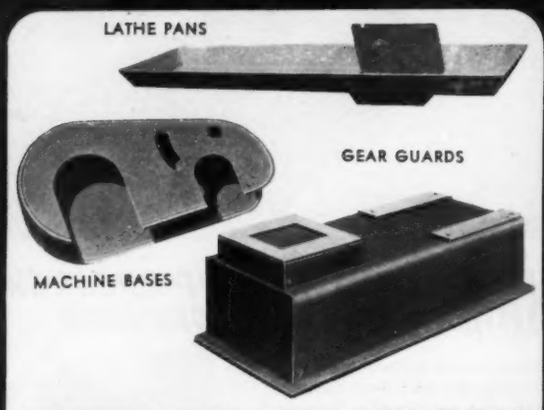

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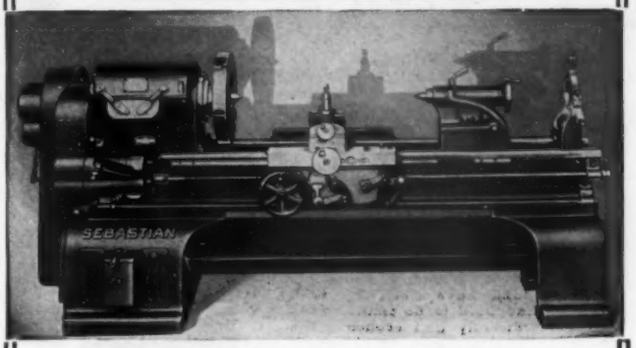

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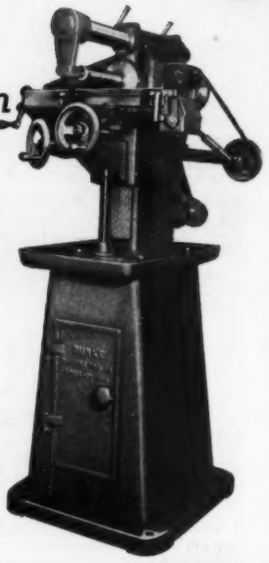

Those small, difficult jobs can be handled on a *production basis* with BURKE Motor Driven Milling Machines Nos. 1, 2, 3 & 4. Primarily, this is because BURKES have been *specially designed* and *built* to do smaller milling jobs efficiently and economically.

Then, too, a number of attachments are available . . . attachments that increase the units usability, and add to your productivity. These include a vertical milling attachment, index centers, and vises — 3 types, including swivel base. Now, when production must be stepped up, is the time to investigate the profit possibilities of BURKE Milling Machines, as applied to your work.

Complete Information Will Be Sent You Upon Request—Write!

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YOU NEED
The New Linley High-Speed Vertical Milling Machine and Jig Borer . . .
To save time and money in your tool room . . . .

Get all the details of this machine—equipped with micrometer screw feed quill—direct reading—assures smooth boring accurately to any predetermined depth up to 3 inches. Write for Descriptive Bulletin M.

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12 Montauk St. Bridgeport, Conn.

HOLMAN *BETTER, FASTER HOLE FINISHING*

HELICAL TAPER PIN REAMERS

Scientifically made of selected steel under modern processes. Long lived, economical, accurate. Details on request.

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MILLING MACHINES, Horizontal
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MILLING MACHINES, Multiple Spindle
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Cincinnati Milling Mach. Co., Cincinnati, Ohio
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Kent-Owens Machine Co., Toledo, Ohio
Knight Machinery Co., W. B., St. Louis, Mo.
Sundstrand Machine Tool Co., Rockford, Ill.

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Niles Tool Wks. Co., Hamilton, Ohio
Putnam Mach. Co., Hamilton, Ohio

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Waltham Machine Works, Waltham, Mass.

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Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Machine Tool Co., Springfield, Mass.

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Cincinnati Milling Mach. Co., Cincinnati, Ohio
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Kearney & Trecker Corp., Milwaukee, Wis.
Knight Machinery Co., W. B., St. Louis, Mo.
Linley Brothers Co., Bridgeport, Conn.
Machinery Manufacturing Co., Los Angeles, Calif.
Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Machine Tool Co., Springfield, Mass.

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Cleveland Automatic Machine Co., Cleveland, Ohio

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General Electric Co., Schenectady, N. Y.

MOTORS, Electric
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Graybar Electric Co. Inc., New York, N. Y.
Reliance Electric & Engineering Co., Cleveland, Ohio
Wesche Electric Co., B. A., Cincinnati, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS, Fractional H. P.
Century Electric Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.

MOTORS, Integral H.P.
Century Electric Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.

MOULDS, Lead Hammer
Johnson Tool Co., East Providence, R. I.

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LIBERTY PLANERS

Featuring: rail heads offset toward center and side heads offset toward top with all heads and tool slides having power rapid traverse and power feed in all directions, dual push button control with automatically clamping motorized rail clamp and electric feed.

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PRESSES, Arbor
Sheldon Machine Co., Chicago, Ill.
Wilson, K. R. Buffalo, N. Y.

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Niagara Machine & Tool Works, Buffalo, N. Y.

PRESSES, Foot & Hand
Niagara Machine & Tool Works, Buffalo, N. Y.

PRESSES, Forging
Lucas Mach. Tool Co., Cleveland, Ohio

PRESSES, Hydraulic
Denison Engineering Co., Columbus, Ohio

PRESSES, Power
Clearing Machine Corp., Clearing, Ill.
Niagara Machine & Tool Works, Buffalo, N. Y.
V. & O. Press Co., Hudson, N. Y.
Zeh & Hahnemann Co., Newark, N. J.

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Morey Machinery Co., Inc., New York, N. Y.
Reed-Prentice Corp., Worcester, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.

PUMPS, Lubricant
Brown & Sharpe Mfg. Co., Providence, R. I.
Ruthman Mach. Co., Cincinnati, Ohio

PUMPS, Oil
Brown & Sharpe Mfg. Co., Providence, R. I.
Ruthman Mach. Co., Cincinnati, Ohio

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Niagara Machine & Tool Works, Buffalo, N. Y.
Wiedemann Mach. Co., Philadelphia, Pa.

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Taft-Peirce Mfg. Co., Woonsocket, R. I.

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Morse Twist Drill & Machine Co., New Bedford, Mass.
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Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Twist Drill Co., Athol, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.

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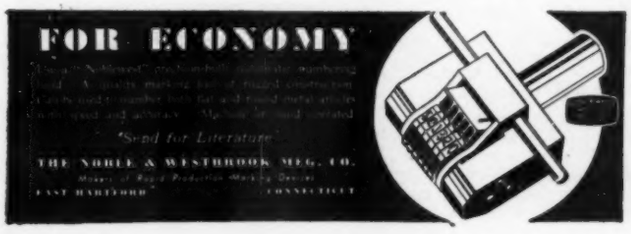
Armstrong-Blum Mfg. Co., Chicago, Ill.

SAWING MACHINES, Circular Saw
Porter-McLeod Machine Tool Co., Hatfield, Mass.



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Many new features speed up manufacture of small parts—increase accuracy. Unique table design gives twelve inch maximum working space.

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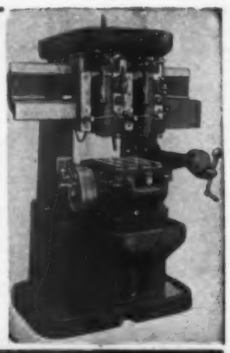

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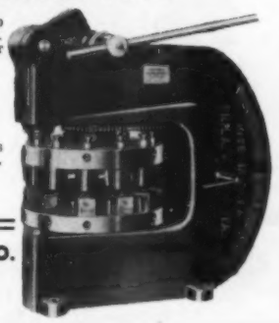
THE 12" THROAT TURRET PUNCH IS A MONEY SAVING TOOL

This machine has 12 punches and dies up to 1" dia. mounted in a revolving turret. It is provided with every convenience for fast, safe and accurate operation.

Capacities in machine steel:
¼" thick, holes up to ⅝" dia.
3/16" thick, holes up to ½" dia.
⅛" thick, holes up to 1" dia.

Simple, inexpensive punches and dies available for accurate holes in copper, aluminum, duralumin, etc.

Full details on request.



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NATIONAL TWIST DRILL & TOOL CO., Detroit, U.S.A.
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for heavy blanking and forming . . . . .

Heavier classes of blanking and forming work can be handled efficiently and economically on these presses.

Sturdily constructed with either solid frame or built up with tie rods. Small elastic deflections do not affect tool alignment. All stresses taken centrally. Made also with wedge adjustment for slide for very close work.

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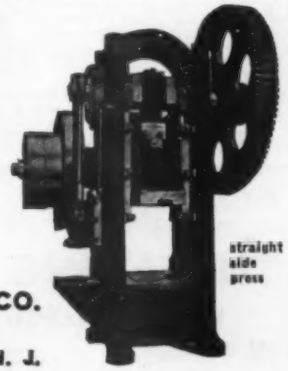

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Entire construction is smooth and simple—no sharp corners to scrape and wear other parts—no screws—no small parts. Friction is minimized; service life extended.

FREE FROM SHARP CORNERS

Alloy steel pins and block are of large dimensions and heat treated. You can depend on "ATLAS" for the maximum in strength and wear resistance. Write for details of standard sizes available.

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RIVETERS—PIONEERS in their line—head rivets from smallest to ¾" diameter either by NOISELESS SPINNING or VIBRATING HAMMER method — Sizes to meet all needs — Types include Vertical and Horizontal Multiple Spindles.

Write for literature and don't forget to send samples.

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TORRINGTON
ROTARY
SWAGING MACHINE

— with 4000 forceful squeezing hammer blows per minute—makes metal tougher and more elastic. Send for booklet—"The Torrington Swaging Machine."

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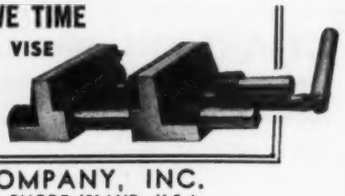
REDUCE NON-PRODUCTIVE TIME
with the SHUR-GRIP DRILL VISE

Pays for itself quickly in time savings —Jaws 5" wide and open 5"—hardened steel with built-in parallels and v-grooves for holding round, square and odd shapes. Price $15.50. Details on request.



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SAWS, Hack, Frames and Blades
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Avey Drilling Machine Co., Cincinnati, Ohio

SAWS, Milling
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Union Twist Drill Co., Athol, Mass.

SAWS, Power Hack
Peerless Machine Co., Racine, Wis.

SAWS, Screw Slotting
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Eastern Mach. Screw Corp., New Haven, Conn.
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Jones & Lamson Mach. Co., Springfield, Vt.

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Standard Pressed Steel Co., Jenkintown, Pa.

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Standard Pressed Steel Co., Jenkintown, Pa.

SCREWS, Safety
Standard Pressed Steel Co., Jenkintown, Pa.

SCREWS, Shoulder
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Standard Pressed Steel Co., Jenkintown, Pa.

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Rockford Machine Tool Co., Rockford, Ill.
Smith & Mills Co., Cincinnati, Ohio

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Mitts & Merrill, Saginaw, Mich.
Niagara Machine & Tool Works, Buffalo, N. Y.

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Allis Chalmers Mfg. Co., Milwaukee, Wis.

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Sugar Beet Products Co., Saginaw, Mich.

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Graybar Electric Co. Inc., New York, N. Y.

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STEEL, Stainless
Allegheny Ludlum Steel Co., Breckenridge, Pa.
Republic Steel Corp., Cleveland, Ohio

STEEL, Tool
Allegheny Ludlum Steel Co., Breckenridge, Pa.
Armstrong Bros. Tool Co., Chicago, Ill.

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Vanadium Alloys Steel Co., Latrobe, Pa.

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Baush Machine Tool Co., Springfield, Mass.
Cincinnati Bickford Tool Co., Cincinnati, Ohio
Errington Mech. Lab., Staten Island, N. Y.
Ettco Tool Co., Brooklyn, N. Y.
Greenlee Bros. & Co., Rockford, Ill.
Haskins Co., R. G., Chicago, Ill.
Kingsbury Mach. Tool Corp., Keene, N. H.
Murchey Machine & Tool Co., Detroit, Mich.

TAPPING MACHINES, Single & Multi-Spindle
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Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mach. Co., Waynesboro, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Murchey Machine & Tool Co., Detroit, Mich.
Winter Brothers, Wrentham, Mass.

TAPS, Ground
Butterfield Division Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Winter Brothers, Wrentham, Mass.

TAPS, Collapsing
Landis Mach. Co., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit, Mich.

TESTING APPARATUS, Hardness
Shore Instrument & Mfg. Co., Jamaica, N. Y.
Wilson Mechanical Instrument Co., New York, N. Y.

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Geometric Tool Co., New Haven, Conn.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mach. Co., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit, Mich.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Waltham Machine Works, Waltham, Mass.
Warner & Swasey Co., Cleveland, Ohio

THREAD CUTTING TOOLS
Eastern Mach. Screw Corp., New Haven, Conn.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mach. Co., Springfield, Vt.
Landis Mach. Co., Waynesboro, Pa.
Modern Tool Works, Rochester, N. Y.
Murchey Machine & Tool Co., Detroit, Mich.
Peerless Machine Co., Racine, Wis.
Rivett Lathe & Grinder, Inc., Boston, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

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Warner & Swasey Co., Cleveland, Ohio

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Armstrong Bros. Tool Co., Chicago, Ill.

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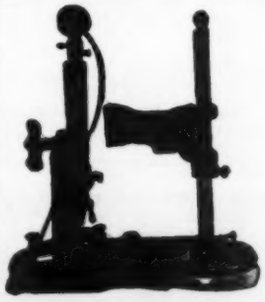
Warner & Swasey Co., Cleveland, Ohio

WALTHAM THREAD MILLER

A semi-automatic machine for production or tool room service. It is best adapted for work 2" in diameter or smaller. Special equipment for short multiple cutter work with cam shaft control can be furnished. A cutter head for internal work can also be supplied.

WALTHAM MACHINE WORKS
HIGH STREET WALTHAM, MASS.



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Jones & Lamson Machine Co., Springfield, Vt.
Ready Tool Co., Bridgeport, Conn.
Warner & Swasey Co., Cleveland, Ohio
Williams & Co., J. H., Buffalo, N. Y.

TOOL POSTS, Lathe
Williams & Co., J. H., Buffalo, N. Y.

TOOL STANDS
Standard Pressed Steel Co., Jenkintown, Pa.

TOOL WORK
Taft-Peirce Mfg. Co., Woonsocket, R. I.

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Carboloy Co., Detroit, Mich.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
Warner & Swasey Co., Cleveland, Ohio

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Jones & Lamson Machine Co., Springfield, Vt.
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Williams & Co., J. H., Buffalo, N. Y.

TOOLS, Pipe Threading
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Warner & Swasey Co., Cleveland, Ohio

TOOLS, Safety
Williams & Co., J. H., Buffalo, N. Y.

TOOLS, Thread Cutting
Williams & Co., J. H., Buffalo, N. Y.

TOOLS, Tungsten Carbide Tipped
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McKenna Metals, Latrobe, Pa.
Warner & Swasey Co., Cleveland, Ohio

TOOLS, Turning
Jones & Lamson Machine Co., Springfield, Vt.
McKenna Metals, Latrobe, Pa.
Warner & Swasey Co., Cleveland, Ohio
Williams & Co., J. H., Buffalo, N. Y.

TOOLS, Turret Lathe and Screw Machine
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Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
Warner & Swasey Co., Cleveland, Ohio

TORCHES, Gas Cutting & Welding
Air Reduction Sales Co., New York, N. Y.

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Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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TRUCKS, Platform Lift
Automatic Transportation Co., Chicago, Ill.

TRUCKS, Steel
Standard Pressed Steel Co., Jenkintown, Pa.

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Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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American Tool Wks. Co., Cincinnati, Ohio
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
Warner & Swasey Co., Cleveland, Ohio

UNIT HEATERS, Gas Fired
Surface Combustion Corp., Toledo, Ohio

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Gray & Prior Machine Co., Hartford, Conn.

USED MACHINERY
Atlantic Machinery Corp., New York N. Y.
Bradley Machry Co., Detroit, Mich.
Central Mach. Tool Corp., Toledo, O.
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Dony Machry. Co., D. E., Rochester, N. Y.
Dreifus Co., Chas., Phila., Pa.
Dubera Corp., New York, N. Y.
Eastern Machinery Co., Cincinnati, Ohio
Emerman & Co., Louis E., Chicago, Ill.
Falk Machinery Co., Inc., Rochester, N. Y.
Hill-Clarke Machinery Co., Chicago, Ill.
Hyman & Sons, Jos., Philadelphia, Pa.
Indianapolis Machinery & Supply Co., Indianapolis, Ind.
Industrial Machry. Co., Columbus, Ohio
Inland Machinery Co., Chicago, Ill.
Interstate Machinery Co., Inc., Chicago, Ill.
Iroquois Machy. Co., Buffalo, N. Y.
Jones Machine Tool Co., Cincinnati, Ohio
Lang Machinery Co., Pittsburgh, Pa.
Lucas & Son, J. L., Bridgeport, Conn.
McDonald Machinery Co., St. Louis, Mo.
Miles Machy. Co., Saginaw, W. S., Mich.
Moorehead-Reitmeyer Co., Pittsburgh, Pa.
Morey & Co., Inc., New York, N. Y.
National Machinery Exchange, New York, N. Y.
Nesbitt Machry. Co., Baltimore, Md.
Nuttall, J., Philadelphia, Pa.
O'Brien Machinery Co., Phila., Pa.
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Ott Mach. Sales Co., Detroit, Mich.
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Sun Machry. Co., Newark, N. J.
Toledo Machry. Exchange Co., Toledo, Ohio
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Wigglesworth Machinery Co., Cambridge, Mass.
Wigglesworth Machinery Co., T. R., Cleveland, O.

VERNIERS
Brown & Sharpe Mfg. Co., Providence, R. I.

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New Britain-Gridley Machine Co., New Britain, Conn.

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Armstrong-Blum Mfg. Co., Chicago, Ill.
Hartford Special Machy. Co., Hartford, Conn.
Johnson Tool Co., East Providence, R. I.
Sheldon Machine Co., Chicago, Ill.

VISES, Machinist
Desmond-Stephan Mfg. Co., Urbana, Ohio
Wiedemann Machine Co., Phila., Pa.

VISES, Milling Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, Ohio
Hartford Special Machy. Co., Hartford, Conn.
Kearney & Trecker Corp., Milwaukee, Wis.
Sheldon Machine Co., Chicago, Ill.

VISES, Pipe
Armstrong Bros. Tool Co., Chicago, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams & Co., J. H., Buffalo, N. Y.

WASHING MACHINES, Metal
Barrett Co., Leon J., Worcester, Mass.

WELDERS, Electric
Ohio Machine Tool Co., Kenton, Ohio

WELDING ELECTRODE HOLDERS
Lincoln Electric Co., Cleveland, Ohio

WELDING ELECTRODES
General Electric Co., Schenectady, N. Y.

WELDING GOGGLES & HELMETS
Lincoln Electric Co., Cleveland, Ohio

WELDING MACHINES, Electric Arc
Hobart Brothers, Troy, Ohio
Lincoln Electric Co., Cleveland, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WELDING RODS
Hobart Brothers, Troy, Ohio

WELDING SUPPLIES, Electric
General Electric Co., Schenectady, N. Y.

WIRE & CABLE, Insulated
General Electric Co., Schenectady, N. Y.

WIRE, Iron, Steel & Copper
Roebling's Sons Co., John A., Trenton, N. J.

WORM DRIVES
Gear Specialties, Inc., Chicago, Ill.
Perkins Mach. & Gear Co., Springfield, Mass.

WORMS
Gear Specialties, Inc., Chicago, Ill.

WRENCHES, Chain
Williams & Co., J. H., Buffalo, N. Y.

WRENCHES, Drop Forged
Williams & Co., J. H., Buffalo, N. Y.

WRENCHES, Machinist
Armstrong Bros. Tool Co., Chicago, Ill.

WRENCHES, Pipe
Armstrong Bros. Tool Co., Chicago, Ill.

WRENCHES, Socket
Armstrong Bros. Tool Co., Chicago, Ill.
Williams & Co., J. H., Buffalo, N. Y.

WRENCHES, Tap
Butterfield Division Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
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Chips

Scraping Challenged . . . . Scraping of machine ways has been a time-honored craftsman's way of fitting. But with current needs for skilled mechanics, it would seem that some mechanical means of doing the job could be developed. It was with considerable anticipation, therefore, that we saw the new Hill Acme precision way grinder, soon to be announced. It has the weight and rigidity essential to the close limits required—and on tests has cut finishing time from a third to a tenth of former hand time. Announcement of it should come along within the month.

Welded Frame . . . . Incidentally, Hill Acme has been developing a welded surface-grinder frame into which the ways are dovetailed and bolted. Bolts are heated just before tightening, so shrink in place to pull the way down into the dovetail. Net results: faster fabrication, no patterns, lower weight with the same rigidity.

More Data . . . . American Machinist had in 1940 the second largest number of advertising pages of any magazine, regardless of type, and largest by far of any fortnightly. Advertising pages in 1940 totalled 3304, in 1939 they totalled 2764 (when AM was third). Improvement 20%. 1940 increase was 540 pages, most of any metalworking publication. Advertising pages in the first ten issues of 1941 totalled 1627.98, an increase of 443.41, or 37%. These days, your subscription dollar grows bigger and bigger in the information it brings you.

Choosey Inspectors. . . . Company after company is building a new office and engineering department, complete with glass brick, fluorescent lights, and air conditioning. It's getting so that Government inspectors assigned to two or three plants make their headquarters at the one with the newest offices.

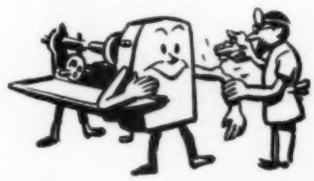
1-Sided Mike . . . We were much interested recently (*AM*, April 16) in the new GE magnetic micrometer. It measures thickness of steel sheet *from one side* to accuracies of a thousandth. Our interest stemmed from the fact that we used to have to drill holes in corrugations of finished railway-car ends to make the thickness after corrugating. This new gadget ends all that. Now comes the further announcement (*AM*, June 11) of a similar mike for non-magnetic materials—making it possible to measure thickness of plating or other finishes.

For Defense . . . . The lobby showcase at Dumore Co., Racine, Wis., exhibits no tools these days. Instead it displays a patriotic picture and a showcard explaining that as fast as the company's products are completed, they're being sent to defense plants.

The Microscope Boys . . . A recent report of the National Research Council states that American industry employs more than 70,000 workers in over 2,200 laboratories at an estimated annual cost of $300,000,000. Looks like industry realizes very definitely that there's a direct connection between research and earning power, both for the company and for the worker.

Boost of the Week. . . . Says D. C. Wright of Trundle Engineering Co., "I have, over the past 30 years, learned to depend on *American Machinist* as a source for instructive operation information. . ."

Bridge of Ships. . . . We read, the other night, that the Romans beat the daylights out of the Carthaginian fleet by equipping their own ships with the *corvus*, a bridge hinged to the deck and lowered overside by a block and tackle on the mast. Tactics up until then had been to ram the other ship or to smash its oars, which took nice seamanship. The inferior Roman sailors could get close enough to let down the *corvus*, and then soldiers (the earliest marines) dashed across and mopped up. The Carthaginians didn't even have soldiers aboard—and thought the new tactics unfair. Further, the Romans built a fleet of 120 ships in *two months*. A far cry from our modern 4-year battleships!



Rejuvenator for Tools . . . . Vascoloy-Ramet produced, in one recent week, as much of its hard cutting materials as it did in the whole year of 1935. That's quite a boost to defense production. Included is a new tougher carbide, to step up cutting speeds on older machine tools.—E. S. T.

ADVERTISERS INDEX

Abrasive Co. 87
Abrasive Machine Tool Co..... 130
Adams Co. 69
Advance Machine Works..... 126
Air Reduction Sales Co..... 54
Allegheny Ludlum Steel Corp..... 57
Allen Manufacturing Co..... 84
American Chain & Cable Co., Inc. 66, 70
American Measuring Instrument Co. 132
American Tool Works Co..... 16
Armstrong-Blum Mfg. Co..... 20
Armstrong Bros. Tool Co..... 17
Arter Grinding Machine Co..... 90
Auto Ordnance Corp. 106
Automatic Transportation Co..... 58
Avey Drilling Machine Co..... 128

Barber-Colman Co. 46
Barnes Drill Co. 132
Barrett Co., Leon J..... 60
Baumbach Mfg. Co., E. A..... 128
Baush Machine Tool Co..... 38
Bilgram Gear & Machine Works.. 70
Blanchard Machine Co..... 36
Blank & Buxton Machinery Co.... 44
Braun Gear Corp..... 70
Bridgeport Safety Emery Wheel Co. 128
Brown & Sharpe Mfg. Co.....45, 106
Bryant Chucking Grinder Co..... 37
Bullard Co. 132
Burke Machine Tool Co..... 134
Business Week 91
Butterfield & Co. (Div. Union Twist Drill Co.) 34

Carboloy Co., Inc.....(Ed.) 633
Card Mfg. Co., S. W. (Div. Union Twist Drill Co.) 35
Carlton Machine Tool Co..... 94
Century Electric Co. 71
Cincinnati Bickford Tool Co..... 47
Cincinnati Gear Co. 69
Cincinnati Grinders, Incorporated 12, 13
Cincinnati Milling Machine Co..6, 7
Cincinnati Planer Co..... 50
Cities Service Oil Co.....(Ed.) 635
Clearing Machine Corp.....22, 23
Cleveland Automatic Machine Co.42, 43
Comtor Co. 110
Cone Automatic Machine Co., Inc.. 40
Consolidated Machine Tool Corp.. 31
Coulter Machine Co., James..... 104
Crafts Co., Inc., Arthur A..... 129
Cullman Wheel Co..... 68

Danly Machine Specialties, Inc.... 129
Davis Keyseater Co..... 132
Dayton Rogers Mfg. Co..... 133
Denison Engineering Co..... 102
Desmond-Stephan Mfg. Co..... 129

Earle Gear & Machine Co..... 69
Eastern Machine Screw Corp..... 80
Electric Furnace Co..... 131
Errington Mechanical Laboratory.. 110
Etna Machine Co..... 99

Fellows Gear Shaper Co.....10, 11
Fitchburg Grinding Machine Corp. (Ed.) 636

ADVERTISERS INDEX

(Continued from preceding page)

	Page
Foote-Burt Co.	41
Ford Motor Co. (Johansson Div.)	108
Fosdick Machine Tool Co.	39
Gallmeyer & Livingston Co.	92
Ganschow Gear Co.	68
Gardner Machine Co.	93
Gear Specialties, Inc.	69
General Electric Co.	28, 32, 55
Geometric Tool Co.	137
Gisholt Machine Co.	29
Gleason Works	3
Goss & deLeeuw Machine Co.	84
Grant Gear Works	68
Grant Mfg. & Machine Co.	136
Gray & Prior Machine Co.	136
Graybar Electric Co. Inc. (Ed.)	634
Greenfield Tap & Die Corp (Ed.)	622
Greenlee Bros.	85
Grob Bros.	128
Hammond Machinery Builders, Inc.	131
Hartford Special Machinery Co.	69, 112
Haskins Co., R. G.	130
Heald Machine Co.	2nd Cover
Hobart Brothers	138
Holman Reamer Co.	134
Hones, Inc., Chas. A.	130
Houghton Co., E. F.	67
Johnson Machine Co., Carlyle	70
Johnson Tool Co.	136
Jones & Lamson Machine Co.	8, 9
Kearney & Trecker Corp. (Ed.)	631
Kent-Owens Machine Co.	101
Kester Solder Co.	58
Kingsbury Machine Tool Corp.	129
Knight Machinery Co., W. B.	107
L-W Chuck Co.	104
Landis Machine Co.	18, 19
Landis Tool Co.	26, 27
La Pointe Machine Tool Co.	74, 75
LeBlond Machine Tool Co., R. K.	30
Leland-Gifford Co.	128
Liberty Planer & Mfg. Co.	134
Lincoln Electric Co.	61
Linley Brothers Co.	134
Littleford Bros.	132
Lodge & Shipley Machine Tool Co.	4, 5
Lucas Machine Tool Co.	126
McCaskey Register Co.	76
McGraw-Hill Book Co.	66, 88, 96, 116
McKenna Metals Co.	110
Machinery Manufacturing Co.	96
Meisel Press Mfg. Co.	69
Metal Carbides Corp.	138
Mitts & Merrill	133
Monarch Machine Tool Co.	25
Morey Machinery Co, Inc.	82, 96, 135
Morse Chain Co.	72
Morse Twist Drill & Machine Co.	97
Murchey Machine & Tool Co.	136
National Broach & Machine Co.	77
National Machine Tool Co.	133
National Twist Drill & Tool Co.	135
Newark Gear Cutting Machine Co.	68
New Britain-Gridley Machine Co	3rd Cover
New Departure Div. General Motors Corp. (Ed.)	620
Niagara Machine & Tool Works	98
Niles Tool Works Co.	94
Noble & Westbrook Mfg. Co.	135
Norton Co.	24
Oakite Products, Inc.	60
Ohio Machine Tool Co.	127
Oliver Instrument Co.	131
Peerless Machine Co.	109
Perkins Machine & Gear Co.	68
Porter-McLeod Machine Tool Co., Inc.	102
Potter & Johnston Machine Co.	79
Prescott Co.	112
Producto Machine Co.	129
Putnam Machine Co.	94
Railway Express Agency, Inc.	88
Randall & Stickney	131
Ready Tool Co.	126
Reed-Prentice Corp.	72A
Reeves Bros., Inc.	126
Reliance Electric & Engineering Co.	56
Republic Steel Corp.	65
Rivett Lathe & Grinder, Inc.	82
Rockford Machine Tool Co.	83
Roebling's Sons Co., John A.	52
Ruthman Machinery Co.	80
Schatz Mfg. Co.	64
Scherr Co., Geo.	104
Sebastian Lathe Co.	133
Sheldon Machine Co.	82
Shore Instrument & Mfg. Co., Inc.	137
Simmons Machine Tool Corp.	92
Smith & Mills Co.	137
Snyder Tool & Engineering Co.	105
Socony Vacuum Oil Co., Inc.	62, 63
South Bend Lathe Works	21
Springfield Machine Tool Co.	89
Square D Co.	73
Standard Pressed Steel Co.	80, 133
Sugar Beet Products Co.	60
Sundstrand Machine Tool Co.	95
Sunnen Products Co.	100
Surface Combustion Corp.	53
Taft-Peirce Mfg. Co.	72B
Thompson Grinder Co.	86
Timken Roller Bearing Co.	4th Cover
Torrington Co.	51, 136
Union Twist Drill Co.	33
Universal Engineering Co.	102
V. & O. Press Co., Inc.	134
Vanadium Alloys Steel Co.	59
Van Norman Machine Tool Co.	14, 15
Victor Machinery Exchange	108
Vitrified Wheel Co.	94
Walker Co., Inc., O. S.	113
Waltham Machine Works	137
Warner & Swasey Co.	48
Wesche Electric Co., B. A.	78
Westinghouse Electric & Mfg. Co.	68
Wiedemann Machine Co.	135
Williams & Co., J. H.	81
Wilson, K. R.	103
Wilson Mechanical Instrument Co.	132
Winter Bros. Inc.	113
Wright Mfg. Div. American Chain & Cable Co., Inc.	66
Zeh & Hahnemann Co.	135

SEARCHLIGHT SECTION

Classified Advertising

Classification	*Page*
BUSINESS OPPORTUNITIES	117
CONTRACT WORK	114-115
Allied Engrg. & Equipment Co., Inc.	115
Bay City Forge Co.	114
Brown & Brown, Inc.	115
W. L. Chalfin Mfg. Co.	115
Edelblute Mfg. Co.	115
Fidelity Mach. Co.	115
General Machine Builders Co.	115
General Pattern Works	114
Greist Mfg. Co.	114
A. H. Hyndman Co., Inc.	114
The Kirk & Blum Mfg. Co.	114
National Machine & Tool Co.	115
A. H. Nilson Machine Co.	115
Phonograph Needle Mfg. Co.	114
Precision Thread Grinding Co.	114
Product Engineering Service	114
A. G. Schultz Co.	114
Thomas & Skinner Steel Products Co.	114
Twix Mfg. Co.	115
Unique Specialties, Inc.	115
Waltham Screw Co.	114
EMPLOYMENT SERVICE	117
PATENT ATTORNEY	117
PLANTS FOR SALE	117
POSITIONS VACANT	117
POSITIONS WANTED	117
PROFESSIONAL SERVICES	117
SELLING OPPORTUNITIES	117
USED SURPLUS EQUIPMENT	118
Advance Manufacturing Co.	125
Atlantic Machinery Corp.	119
Bradley Machinery Co.	118
Central Machine Tool Corp.	120
Cincinnati Machinery & Supply Co.	122
DeWitt Tool Co.	122
Dony Machinery Co., D. E.	120
Dreifus Co., Chas.	125
Eastern Machinery Co.	123
Emerman & Co., Louis E.	125
Falk Machinery Co., Inc.	121
Hill-Clarke Machinery Co.	120-123
Hyman & Son, Joseph	120
Indianapolis Machy. & Supply Co., Inc.	120
Hackett Co., J. Lee	125
Iroquois Machy. Co.	120
Lang Machy. Co.	125
Miles Machinery Co.	122
Mills-Gavan Machinery Sales	125
Morey Machinery Co., Inc.	118
National Machinery Exchange	122
Nesbitt Machinery Co.	124
Nuttall, J.	122
O'Brien Machy. Co.	120
Osborne & Sexton Machinery Co.	120
Ott Machinery Sales, Inc.	120
Reliance Mchy. Sales Co.	122
Simmons Machine Tool Corp.	118
Strong, Carlisle & Hammond Co.	120
Sun Machinery Co., Inc.	122
West Penn Machinery Co.	122
Wigglesworth Machinery Co.	125